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ELECTRIC PORCH LIGHTS.

The development of the porch light field deserves the consideration of every central station desiring to increase its business. One has only to walk after dark down a residence street of the city in which he lives to realize the opportunity that awaits the electric light companies in the direction of clearing up the mysteries of illegible house-numbers, which ought to be regarded as relics of barbarism by every residential user of the incandescent lamp.

In some localities the use of the porch light in a numbered globe has been taken up with enthusiasm. The cost of an eight-candle-power service for three and one-half hours each evening may be quoted as half a cent in some cases and yet be made profitable by the central station. The use of sixteen-candle-power lamps is worth encouraging, but in any event it is important to sell current at a small profit rather than not to sell it at all. The annoyance of needless calls to the door is often great in cities where the residence numbers are indistinguishable, and the safety and convenience of such a light may easily outweigh its low cost, from the consumer's standpoint.

ELECTRIC RAILWAY PROBLEMS.

The field of electrical application which seems to attract the most general interest is the introduction of the electric motor in place of other methods of propulsion. This, no doubt, is because of the character of the work which is being done by the electric car. It has revolutionized city transportation, has brought outlying districts within easy reach of business centres, and has spread out our city population and greatly reduced the cost of riding. These things appeal to the average man. He appreciates more fully what has been done by the electric railway than by other applications such as the electric light, and therefore possibly thinks that changes equally as great are imminent in larger railway work—larger in the sense of hauling greater loads and heavier trains. He does not realize that the problems presented in the two cases are entirely different.

This lack of appreciation of the true situation is only natural—in fact, the first electric railway work was done, not by railway engineers, but by so-called electricians, who attempted to substitute the motor for the horse, and hence built up a system from old horse-car practice. Had these pioneers known more about railway work, it might have saved much time; but, on the other hand, had they known what demands would be made upon the motors, they would probably have hesitated before submitting them to such service. They rather naturally assumed that if two horses were sufficient to move a car, a five or, at the most, a seven-horse-power motor would meet all demands. This belief was the cause of many unsuccessful electric cars, but resulted in the production of a motor truly wonderful for the work which it performs and for its suitability to the work required.

Now, in other lines of railway work, there are many problems to be solved before the motor can have universal sway. There are, in fact, several different kinds of service, each presenting peculiar conditions, and calling for a peculiar equipment. We have the city service, high-speed interurban service, long-distance passenger and heavy freight service, and possibly in the not distant future what we may call extra high-speed lines between important cities. To these we might add a fifth class—rural lines: light roads cheaply constructed, and intended to serve districts where a standard trolley service could not pay.

For the first of these classes we have what we may consider a practically perfected system. The overhead or underground trolley using direct-current series motors will probably remain unchanged for some time, unless the necessity of meeting conditions outside of cities makes a compromise desirable. The high-

speed interurban lines have until recently been equipped with direct-current motors, and have, on the whole, been successful; but the high cost of such a system has been the lever which has forced electric railway engineers to develop alternating-current, single-phase systems, designed to reduce the cost by saving in copper transmission lines and in substation machinery. The direct-current motor itself performs the service required of it satisfactorily, and the aim has been to obtain an alternating-current motor having the same characteristics.

Coming now to steam railway systems, we find several classes of work, each of which requires special treatment. There is the suburban traffic, which the road can not afford to give up to competing trolleys. This is best handled by an extension of the system found suitable for heavy city work, in which two or more large cars are coupled to form a train of the desired length, controlled from one point. It differs only from the surface car system in having a larger equipment on each car and in the method of controlling the motors. The motors themselves are simply large motors of the usual type.

The through passenger and heavy freight traffic, on the other hand, can not be handled in the same way. The express train makes long runs with few stops, calling for heavy trains and high speeds, hence rapid starting is not as important as in city work. The problem, principally, is to supply power at irregular times to a long stretch of track. To do this by extending the system found so satisfactory for city work is hardly possible on account of the expense. For the present, at least, this service can only be given by a locomotive, because our express trains of to-day are made up of cars running between widely separated cities; and until such route has been electrified throughout, it will be out of the question to equip the cars with motors. The problem in hauling freight is pretty much the same, except that the trains are heavier; but there is no need to make the same speed, and in freight haulage there is less possibility of equipping the individual cars with motors. It is evident that the problem presented in these two cases is widely different from that of urban and interurban work, and, from the magnitude of the work itself, that progress must be slow. Up to the present time, where changes from steam operation to electric have been made, or are in process of making, other and special considerations have entered and have forced the change.

There is no necessity to-day of providing extra high-speed service, though possibly the demand will arise in the near future. Already some important experimental work has been done in this field, and it has been shown that such service can be rendered by an electric system. It is now practically a commercial question. When sufficient demand arises, and it appears that the traffic will pay for the necessarily great expense, the high-speed road will come.

A different situation exists in the rural districts. While there are large sections of the country amply supplied with transportation facilities—either steam or electric, or both—there are still large districts where there is little or no railroad service. It has been suggested a number of times that a light electric road would meet the demands of these districts, and, if properly constructed, it would pay well. On another page of this issue this proposal is considered again by Dr. Louis Bell, who points out the needs of the rural districts and indicates how these should be met. The first thing that should be recognized is that a light road is needed. The builders must resist the temptation to make a standard road.

We have indicated above briefly the principal traction problems which are now confronting the electrical engineers. As has been shown, they differ considerably, a system admirably adapted for one being not at all suited for another. There is, however, no question about the possibility of doing all this work electrically. The main question to-day is merely, will it pay, and it is to answer this question and devise a system which will be profitable that the electrical engineer is directing his efforts. He is confident that, in the end, success will be his, but he does not anticipate overthrowing present railway practice in a night.

SELF-PROPELLED FIRE ENGINES.

It is reported that the municipal authorities of Vienna, Austria, have decided to reequip the city's professional fire-brigade, together with the auxiliary suburban volunteer fire-brigades, entirely with self-propelled vehicles. The city has already ordered fifty-three motor chemical engines, to replace the horse chemical engines of the professional service and of the volunteer brigades, which own their own horses. The Vienna fire service has long been held up as a model on the Continent, and the present step is thought to be one of the most important which it has taken, if not the most important in the history of fire-protection service. Although the equipment will be expensive, it is said that it will effect an annual saving of over $15,000. The cost of the change will be in the neighborhood of $180,000.

Attention has been called several times to the use of automobile fire engines, and the hope expressed that a city in this country would try them. They would seem to have some important advantages. It is most essential to get to a fire as soon as possible, and no effort is spared in training men and horses to obtain this end. In large cities, where there are many engines, there is pretty sure to be one in every important locality, so that the scene of trouble is reached quickly; but it would be reached still more quickly by means of a self-propelled vehicle, which is always ready to start, and which can make much better time on the streets because of its greater speed and the ease with which it can worm its way through a crowd of vehicles. If the steam pump is to be retained, it would be natural to propel the engine by means of steam, but much may be said in favor of an electric machine. The battery equipment of such a machine need not be large, since in no case would the distance to be covered be great. The supply for operating the motors would, of course, be drawn from suitable stations, which should be located at each fire-hydrant. Each machine would naturally be fully equipped with smoke helmets, a telephone, portable lights, and all the other modern appliances which greatly aid the fireman in his work.

A SIMPLE EXPERIMENTAL FURNACE.

In a paper read recently before the Faraday Society, of England, Messrs. R. S. Hutton and W. H. Patterson described a simple form of experimental furnace which has been devised by themselves. This is simply a tube of carbon which forms, at one time, the containing-chamber and the conductor. Heating is effected by passing current through the tube, the substance to be experimented with being placed in the tube.

It was found that this type of furnace gave a uniform temperature throughout, its only disadvantage being the presence of the carbon. The first tubes were formed of graphite, machined to the shape desired, but these being rather expensive, later tubes were made of agglomerated carbon pressed into proper form and baked. As this carbon becomes incandescent when heated, it must be protected from contact with the air. The best protection found was fine carborundum, which is packed around the outside of the tube. Carborundum, being not only a non-conductor of heat, but a reducing agent, retains the heat and excludes air and thus prevents combustion of the carbon tube. The inner layers of the material become fritted together, forming a non-conducting tube.

When a research is to be carried out in a pure gas, a double furnace is constructed, a second tube of carbon being placed around the outer, which allows the inner tube to be filled and surrounded completely by the pure gas. One of the problems to be solved in the development of this furnace was that of obtaining a good contact between the carbon tubes and the metallic conductors. This was finally accomplished by copper-plating the ends of the tube and soldering to these ends water-jacketed terminals. The circulation of water through the terminals keeps them cool, and the electric contact is excellent.

A convenient feature of this furnace is the rapidity with which high temperatures may be obtained. For example, with an agglomerated carbon tube one and one-half centimetres internal diameter, two centimetres external diameter, and twenty centimetres long, surrounded outside with a second carbon tube, and outside of the latter by carborundum, a current of 200 amperes at twenty-one volts melted nickel wire in three minutes. Increasing the current to 240 amperes at twenty-five volts melted platinum in two and one-half minutes more. A tube sixty centimetres long and 8.2 centimetres external diameter, 6.7 centimetres internal diameter, supported 600 amperes at 8.6 volts, and gave a temperature of 1,200 degrees centigrade in thirty minutes, with the temperature still rising seven degrees per minute. When the voltage was raised to thirteen, the current increased to 850 amperes. This furnace melted nickel in twelve minutes, and platinum in twenty.

This ingenious type of furnace should be acceptable for experimental researches in which the presence of carbon is not deleterious. Its advantages are, of course, its simplicity and the rapidity with which the desired temperature may be reached. While in the particular experiments mentioned above direct currents were used, alternating currents will be just as satisfactory, and probably, in most laboratories, more easily obtained. The electric furnace is becoming an exceedingly important instrument in chemical research. Happily, the best work can be done by simple and inexpensive devices.

THE INCANDESCENT LAMP AS A FOOT-WARMER.

One of the New York daily papers described recently a use of the incandescent lamp for which it is not intended. It is said that an ingenious salesman, by means of a thirty-two-candle-power lamp and an extension cord, constructed a foot-warmer by means of which he managed to sleep comfortably during the coldest weather in a miserably heated hotel. There is no question that this could be done, for the incandescent lamp is, unfortunately, a much better heater than lamp; but we must vigorously condemn any such use of it. We are glad to see that our contemporary, in a humorous way, throws cold water on the scheme, although it does not point out the real danger. It is not impossible that, as suggested, a restless sleeper might break a lamp placed under the bed covers, and should he do this, he might cut his foot on the broken glass; but there would be little danger of fire arising from the accident. The real danger of fire exists before the lamp is broken.

A thirty-two-candle-power incandescent lamp absorbs about 100 watts. Placed under the bed covers, all of this energy is converted into heat, and as the lamp is comparatively small, and the covers good heat insulators, it does not take long for a high temperature to be attained. This supply of energy at the rate of 100 watts is equivalent to 5.7 British thermal units per minute, which would be sufficient to raise one pint of water about fifty-seven degrees in ten minutes. When the lamp is closely surrounded by a non-conductive material, it does not take long for the latter to be heated to a dangerous point. One can test this easily for himself by wrapping a thick cloth about an incandescent lamp when it is lighted. In a few minutes the cloth will be smouldering, and possibly break into flame. When such a condition is not merely likely, but almost certain to occur, there is no necessity of dwelling upon the inadvisability of obtaining a comfortable night's rest by the means suggested.

It is a fact that possibly the greatest danger of fire from an incandescent lamp arises from this cause, because many persons who should know better seem to forget that it gives off heat, and therefore provision should be made for dissipating this. In other words, the lamp should not be placed in an enclosed position, unless it is surrounded by fireproof material, and it should not come in contact with anything combustible. This is one of the requirements of the fire underwriters, and it is something that should be known by every one.

The salesman referred to might very properly have made use of his incandescent lamp in place of the old-time warming-pan for taking the chill from his bed; or he might have wrapped it in some fireproof material, and then used it safely as a foot-warmer. But one may ask why he did not use an electrically heated mat, which is not only safe, but much more comfortable than a hot lamp.

THE INTERNATIONAL RAILWAY CONGRESS.

TO BE HELD AT WASHINGTON, D. C., MAY 3 TO 14, 1905.

The seventh session of the International Railway Congress will be held at Washington, D. C., May 3 to 14, 1905. The following programme has been announced:

April 29 to May 2, arrival of delegates.

Wednesday, May 3, from 11 A. M. to 2 P. M., registration of members of the congress. The office of the general secretary of the permanent commission will be at the New Willard Hotel, Washington.

Thursday, May 4, 11 A. M., formal opening of the congress. This will be held in the large banquet hall of the New Willard Hotel. Election of president and officers.

The sections will meet as follows:

First Section—Ebbitt House.

Second Section—New Willard Hotel, north end.

Third Section—New Willard Hotel, south end.

Fourth Section—Raleigh Hotel.

Fifth Section—Hearing room of the Interstate Commerce Commission.

On Friday and Saturday, May 5 and 6, at 9.30 A. M. and 2 P. M., there will be meetings of the sections.

Sunday, May 7, will be given up to resting.

On Monday and Tuesday, May 8 and 9, at 9.30 A. M. and 2 P. M., there will be meetings of the sections. At 7.30 P. M. Tuesday, May 9, there will be a banquet given by the American Railway Association.

Wednesday, May 10, at 9.30 A. M. and 2 P. M., there will be meetings of the sections.

Thursday, May 11, there will be a meeting of the sections at 9.30 A. M. At 2 P. M. there will be a general meeting followed by a banquet.

Friday, May 12, 9.30 A. M., meeting of the sections. At 2 P. M., general meeting.

Saturday, May 13, at 9.30 A. M., meeting of the sections. At 2 P. M., general meeting and formal closing of the session.

Sunday, May 14, departure on tours of inspection which will be tendered to the foreign delegates. The exact itinerary of these tours and the hour of departure from Washington on the special trains will be announced later. The itinerary will be about as follows:

The Short Tour—Visits to Altoona, Pa., Pittsburg, Pa., Cleveland, Ohio, Buffalo, N. Y., Niagara Falls, Schenectady, N. Y., and Boston, Mass. This tour will occupy the time from the evening of Sunday, May 14, to the morning of Tuesday, May 23. The party will arrive on the return at New York. The total length of this trip is about 1,500 miles.

The Long Tour—Visits to Altoona, Pa., Pittsburg, Pa., Cincinnati, Ohio, St. Louis, Mo., Chicago, Ill., Buffalo, N. Y., including Niagara Falls, Montreal, Canada, and Schenectady and Saratoga, N. Y. This tour will occupy the time from the evening of Sunday, May 14, to the evening of Saturday, May 27, when the party will arrive on the return at New York. The total length of the trip is about 2,700 miles.

Election traction will be discussed by Section 2, under the general questions of "Progress Made in Electric Traction on Important Lines of Railways," "Continuous Current, Alternating Current, Polyphase Current," and "Experiments Made with High-Tension Currents."

The reporters are as follows:

America—Mr. W. F. D. Young; electrical engineer, Baltimore & Ohio Railroad.

France—Mr. Paul Dubois; engineer of bridges and highways; engineer of the central service motive power, of the Orleans Railroad, Paris.

Great Britain and Belgium—Mr. Ernest Gerard, general inspector; chief of the cabinet of the Belgium minister of railways, Brussels.

Other Countries—Mr. Victor Isemontani, chief inspector of the electrical section of the Mediterranean Railway, Milan.

The lighting, heating, and ventilating of trains will be discussed by Section 2 and Section 3 conjointly.

Automatic block systems will be discussed by Section 3.

The entertainment of the delegates in New York on May 1 will include visits to the power stations of the Interborough Rapid Transit Company and passenger stations and freight terminals of the railroads running into New York and New Jersey.

At Pittsburg the delegates will visit the works of the Westinghouse Electric and Manufacturing Company, where luncheon will be tendered Tuesday, May 16.

At Schenectady, a trip will be made through the works of the General Electric Company's plant, Saturday, May 20.

At Cincinnati, a party will visit the works of the Bullock Electric Manufacturing Company at Norwood. Luncheon will be served after the inspection of the works.

The American Railway Appliance Exhibition, which will be held in Washington from May 1 to 14, in connection with the International Railway Congress, will present, on an elaborate scale, a varied exhibition of still and moving railway apparatus and kindred appliances. Monument Park has been selected as the site for the exhibition grounds. A main exhibit building with a floor space of some 21,000 square feet will contain the larger portion of the set apparatus. In addition, the balance of the nine acres of the park will be utilized by manufacturing companies, which will erect booths of their own, the moving exhibits being relegated exclusively to one section of the park. This is, of course, because of the difficulty of transmitting power too far away from the power-house. It is anticipated that this will be the most notable exhibition of railway appliances that the world has ever seen.

The Annual Convention of the Iowa Electrical Association.

The annual convention of the Iowa Electrical Association was held at Dubuque, April 19, 20 and 21. There were some 100 members in attendance, the visitors being welcomed by Mayor Berg, the response being made by Mr. Bowers, president of the association. Following the executive business of the convention, a paper was read on "Methods of Obtaining New Business," by L. D. Mathes, of Dubuque. This paper was discussed by Messrs. McGee, Bellamy, Zahm and Burt. Mr. W. J. Greene, of Cedar Rapids, introduced a proposal to increase the dues of members in the larger cities.

The afternoon of April 19 was taken up with committee reports and two papers. These were "Boiler-Room Economies," by F. H. Lankashier, of Davenport, and "Methods of Accounting," by A. W. Zahm, of Mason City.

Manufacturers of electrical apparatus were represented at the convention. Among these the National Electric Company, Milwaukee, Wis., made a prominent exhibit. The new universal Lundell motor was shown. The design of this motor has recently been described in the technical press all over the country. The "National Electrical Catechism," a new publication which the National company is distributing, was given away, as were various catalogues, mailing cards and other literature. The National souvenir watch fob, bearing as a charm a bas-relief representation of the company's trademark, was also distributed. The company's interests were represented by Ashley P. Peck, electrical sales agent; J. Frank Perry, sales engineer, and H. M. Klingenfeld, advertising manager.

The Efficiency of the Incandescent Lamp.

To the Editor of the Electrical Review:

The editorial in your issue of the twenty-second instant, on the methods of measuring the radiations of an incandescent lamp filament producing the sensation of light and of separating them from the non-luminous radiations, is most interesting. The problem is, as you say, rendered exceedingly difficult by the fact that of the wavelengths that produce the sensation of light, all probably do not have an effect on the eye proportional to the actual amount of energy transferred, and it is further practically impossible to make any such determinations, as the eye is unable, for instance, to balance in the photometer the brightness of a red light against that of a green light.

I believe, however, that the explanation of this question can be nicely illustrated by further use of the mechanical analogy cited by Professor Kent. He says: "it takes mechanical energy to cause a steel spring to vibrate, but after it has been brought up to its normal period of vibration, it requires no further expenditure of energy to keep it vibrating except that necessary to overcome the resistance of the air and, possibly, a trifling molecular friction."

It is not quite plain whether by "the resistance of the air" Professor Kent means only the skin friction, shock and minute eddies caused by the spring passing rapidly through the air, or also includes those regular pulses sent out through an elastic medium, such as the air and most liquids and solids; and which, if of sufficient intensity and the right periodicity, affect our auditory organs as sound. These impede and carry energy from the vibrating spring just as surely as internal molecular friction or the external friction against the surrounding medium, and if the vibrating body is of the right shape they carry energy away very rapidly and are the principal means of bringing it to rest, especially if its mass is small in proportion to the surface imparting vibration to the air, as witness the exceedingly brief time of, although powerful, vibration of a drumhead.

This same mechanical illustration may be used to explain several other phases of the subject. If we will choose, rather than a tuning fork or simple thing, a body of some other shape having, when struck, complex vibrations of different periodicities, part of the energy of the blow may be expended in the permanent distortion of the material and heat, some may be used in mechanical friction against the air, another portion may be sent out as air-waves of a periodicity either too high or too low to affect the ear, and a small portion may appear as waves distinguishable by the sense of hearing. If, for instance, we were to determine the comparative efficiencies of two types of bells, it would be first necessary to measure the energy input of each in foot-pounds in the hammer blows when the sounds produced by the respective bells were apparently equal under the same conditions of distance and direction, this would give a rating similar to "watts per candlepower."

If we further wished to determine the actual proportion of the energy appearing in air-waves affecting the ear, or as "sound," we would have a very difficult problem, for, as far as I know, no one has ever perfected a method of sifting out the waves of different periodicity, as can be done with light by means of the prism, the diffraction grating, or medium transparent to some rays and not to others. Furthermore, the same difficulty that is found in balancing lights of different colors would arise in balancing the loudness of a sound of high pitch against that of one of low pitch.

George H. Gibson.

New York, April 24.

Meeting of the National Conference on Standard Electrical Rules.

The National Conference on Standard Electrical Rules held its third meeting at Boston, Mass., on Thursday, April 20, to consider the relation of the manufacturing and operative electrical interests with the underwriters' electric rules.

The following organizations were represented by delegates:

American Institute of Architects, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Street Railway Association, Association of Edison Illuminating Companies, Associated Factory Mutual Insurance Companies, International Association of Municipal Electricians, International Association of Fire Engineers, National Board of Fire Underwriters, National Electrical Contractors' Association, National Electric Light Association, Underwriters' National Electric Association; and on the part of manufacturers and operating companies there were persons representing the American Telephone and Telegraph Company, Chicago Edison Illuminating Company, Edison Electric Illuminating Company, General Electric Company, Postal Telegraph-Cable Company, Western Union Telegraph Company, Westinghouse Electric and Manufacturing Company, Pacific Coast Transmission Association and the representatives of a large number of operating electric light and power companies.

The principal action of the conference was to approve a change of the notice on the flyleaf of the National Electrical Code from the statement of approval which has been continued ever since the first issue of this code in 1897. This notice was the result of the work of the first meeting of the conference in March, 1896, which prepared, through its code committee, the electric rules adopted by the National Board of Fire Underwriters. It was felt by the conference that the subsequent editions in which these rules had been amended and others added, without action of the conference or the approval of the organizations composing the conference, had altered the relation of the conference to these rules.

In place of this statement, another was adopted containing an historical statement of the formation of these rules of the edition of 1897, and the names of the organizations forming the conference.

In regard to future relations between the electric interests in the conference and the Underwriters an arrangement was entered into by Mr. C. M. Goddard, secretary of the Underwriters' National Electric Association, in which notice of proposed changes in the rules should be submitted to the secretary of the conference for distribution to its members in advance of the annual meeting in December of each year.

The discussion throughout the meeting was active.

New Apparatus for Mechanically Checking Recording Wattmeters.

A description is given by Dr. A. Gradenwitz of an ingenious little device invented by M. F. Biermann for checking recording wattmeters. The device was brought out in order to satisfy that class of consumers which always regards with suspicion the indications of the usual type of meter. The machine is merely a mechanical recorder which is operated by means of a relay. The relay itself is actuated by a little commutator attached to the revolving part of the recording wattmeter. This commutator completes a circuit through the relay once during every revolution. At this moment the relay attracts its armature, and the latter, by means of a ratchet, shifts a light shaft

forward one notch. The revolutions of this shaft are recorded by means of a series of discs in the method common in such mechanical counters. The shaft, at the same time, drives the second shaft through gears, and this second shaft, two other sets of recording dials. The first set of dials merely records the number of revolutions of the wattmeter disc. The second set records, by means of a suitably selected gear ratio, the watt-hours or ampere-hours, according to the type of meter employed. The third set of discs indicates the amount of the bill. These gear ratios must, of course, be changed for different meters and for different prices of the supply. These three sets of discs are arranged in line, and opposite them is a small plate which can be forced against them by means of a lever. When a record is to be taken, a blank sheet is placed upon this plate, the lever is turned and the paper forced against the dials. In this way a record is made not only of the number of revolutions of the wattmeter, but of the actual consumption of current or energy, and of the amount of the bill. The record obtained from the first set of discs is continuous, while that from the other two is for the time which has elapsed since the last reading. The latter are set at zero after each record has been taken.—*La Revue Pratique de l'Electricité (Paris), April 5.*

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

CABLES FOR MINING WORK.

Cables are perhaps the most important part of any electrical equipment, because they are so difficult to control. They are more or less hidden, and they are always giving more or less trouble. Two substances have been used in mining work, so far, india-rubber and bitumen. In my experience, up to the present, india-rubber has been the only substance that would stand, and that only if you had plenty of it and protected it well from moisture. My idea of a cable for mining work has been at least one-tenth-inch radial thickness of rubber, made up in the usual way, the different coatings being well vulcanized together so as to form a continuous tube, with the tube well protected by as much jute yarn laid on outside as you could, the yarn to be well impregnated with some waterproof substance, and treated pretty frequently to doses of the same substance. But this makes an expensive cable, and mine owners ask if there is nothing cheaper. And so bitumen has been used very largely. I used bitumen many years ago, but was obliged to abandon it as it was unreliable. It would crack and allow moisture to enter, with the result that the cable was parted, and there was trouble generally. Bitumen softens at low temperature, and is amenable to the action of the salts that are found in the water in coal-pits. Lately, however, a modification of bitumen has been put upon the market, known as "Dialite," which is very much less expensive than rubber and claims to be better even than rubber in many respects. It is made by adding certain substances to the bitumen after it has been refined and before vulcanizing, the result of the addition being the production of a very much harder substance that melts at a much higher temperature than bitumen and, it is claimed, will stand a higher temperature than rubber; that is not attacked by moisture, even when the water from which it is taken is impregnated with salts, as pit-water so often is. It has been upon the market some four years, and apparently promises well. Another interesting development in cables is the bitumen-covered paper cables that Messrs. Glover have brought out some time since. Paper cables have been used to a great extent in street work, in England, rubber having failed, in the opinion of borough electrical engineers. But it has only been used to a small extent in mines, for the reason that it is difficult to ensure immunity from the ingress of moisture to the paper. Lead is attacked by the acids so often found in pit-water, and it is liable to have cracks developed in it, admitting moisture, with the well-known results. Messrs. Glover have prepared paper cables with bitumen tubes in place of lead. The development is an exceedingly interesting one. The question is will the bitumen tube prevent the ingress of moisture more than the lead tube does. Bitumen is not subject to electrolysis, as lead is, and there is a distinct advantage in having an insulator in place of a conductor on the other side of the insulator.

It is perhaps interesting to note that there is rubber and rubber. The best comes from the district known generically as Para, in South America, and the worst from West Africa. The prices range from five shillings a pound down to one shilling a pound. Rubber contains, so experts inform me, a germ that renders it unfit for use alone, outside copper. The addition of sulphur in the vulcanizing process kills the germ, but if too much sulphur is put in the resultant product is bad, while if too little the deterioration which the germ sets up is only delayed. West African rubber contains much more of the germ than Para, and therefore requires more sulphur. It is possible, however, to make a cable insulated with West African, or other inferior, rubber that shall apparently be as good as Para, but which will have a very short life. If either the crude rubber or the crude bitumen is not thoroughly cleaned, if small foreign substances are left in them, the results are very disastrous. The common practice with rubber-insulated cables in England that are to be used for electric light or power is to employ only Para rubber, and to place a thin layer of pure rubber next to the conductor, then a layer of what is termed separator, vulcanized by addition of a salt containing sulphur, such as sulphide of antimony, then a further layer called jacket, well vulcanized, the whole being heated together. The pure rubber takes some sulphur from the separator, the separator takes some sulphur from the jacket. The whole becomes one tube of vulcanized material.

THE HOME OFFICE RULES FOR THE USE OF ELECTRICITY IN COAL MINES.

The rules proposed by the Home Office have been issued. They were sent to every coal mine in the United Kingdom, with an intimation that unless an objection was lodged within twenty days of the receipt of the rules, they would be considered to be established at each mine that had not objected. There are fifty-nine rules in the present set, as against a hundred odd in the previous set. Further, the new rules are to be observed as far as is reasonably practicable. There is no mention of who is to judge as to practicability, but there can hardly be any doubt that his Majesty's inspectors will be the judges, *de facto,* if not *de jure.* The rules themselves are very reasonable, and if they are applied with the usual give and take that is necessary in all industrial matters, and particularly in mining, they should at least not hamper the industry. The requirements demanded by the rules are in themselves fair and reasonable. There is only one point where I should be inclined to differ from the rules, to any appreciable extent, and that is on the vexed question of "earth." Evidently this has been a battle-ground in the negotiations that have taken place. Where a medium pressure supply is used, for power, for arcs in series or for incandescent lamps in series, the wires or connections to the motors, transformers or lamps or otherwise in connection with the supply shall be, as far as is practicable, completely encased in strong armoring or metal casing efficiently connected to "earth." And in the section devoted to cables it is stated that where lead-covered cables are used, the lead covering shall be continuous and connected to "earth." There is a saving clause in the general rules dealing with the matter. The cables, etc., may be fixed sufficiently far apart to prevent fire or shock and they need then not be armored. In the cables section, also, the rules have given in to the concentric cable men. In the original rules concentric cables with the outer earthed were practically forbidden. In the present rules they are allowed, and in addition the middle wire of three-wire systems and the neutral of three-phase are allowed to be earthed at one point. In every generating and transforming station earth or fault detectors are to be kept permanently connected up to show immediately any defects in the insulation of the system. The readings of these instruments are to be entered in a book kept for the purpose, at the generating and transforming stations. My view is that registration of insulation at as frequent intervals as possible is the right thing, but a permanent earth connection, whether to armor or through an instrument, is wrong. Further, the earthing of the outer or the neutral of a system at one point only is inviting trouble. There is always a distinct difference of pressure between the two ends of the outer covering of a cable if it is a conductor.

RURAL ELECTRIC ROADS.

BY DR. LOUIS BELL.

It has long been the writer's opinion that there exists a field for profitable electric traction that has been up to the present time almost wholly undeveloped. This is the field of distinctly rural traffic which lacks the density requisite for the support of ordinary interurban enterprises, but yet is quite sufficient to justify roads built on a less ambitious scale. One must realize at the start that there are and must continue to be many communities of limited, but still stable, population not yet in touch with railroad transportation, while furnishing in the aggregate a good amount of traffic. Some few of these communities are already served by electric roads of the ordinary sort, but, save in localities where the roads can find termini capable of supplying a considerable amount of business, commercial success is very problematical, and the list of unsuccessful electric roads, fortunately not a long one, is mainly composed of lines touching only rather small communities.

The cost of a standard electric line, even when most economically constructed, involves considerable fixed charges quite independent of the traffic, and the net receipts after paying operating expenses must be large enough to take care of these fixed charges, which they sometimes fail to do. For example, a road which carries a funded capitalization of $20,000 per mile and operates on fifty per cent of its gross earnings, which is a very low figure, must earn $3,000 to $4,000 per mile at least to take care of its fixed charges and maintain the physical value of its system. If its earnings fall to $2,000 per mile, a reorganization is imminent. Nevertheless, a light electric road can be built at a figure that would make it a profitable and permanent investment on the basis of $2,000 per mile gross earnings or even less. But to succeed such a road must be frankly built as a light railway and must plan for traffic accordingly. It can not maintain the airs and graces of an interurban system upon the prospect that lies before it, but it can do its work, pay dividends, and be of inestimable value to the community in which it operates. It must depend upon its own territory save as it became a useful feeder to some existing railway, as will frequently happen. Its competitor is not the trunk line, but the wagon, and if its locality be well chosen it will become a short cut for both freight and passenger traffic and can gather up a very respectable amount of business.

The recent development of simple alternating motors for electric traction ought to give an impetus to this sort of railway construction, since the new system minimizes the cost of the necessary electrical distribution, reducing it in all ordinary cases to a single trolley wire, for which a cheap and light overhead construction will suffice. For the class of service intended, moderate speed and light rolling stock suffice, so that the actual amount of power can be kept low. Thereby its supply is rendered the more simple, for in many cases it could be readily obtained *via* a frequency changer and a short transmission from some existing electrical supply station. In more ambitious projects one of the many small water powers common in a hilly country could be utilized to advantage, the extreme simplicity of the necessary equipment tending to keep down the first cost and the operating charges to very modest figures. It does not take much of a power station to operate two or three light cars at eight or ten miles per hour upon a road half a dozen miles long, and yet this equipment is amply sufficient to meet the requirements of many a community quite able to furnish traffic enough for good profits upon the modest investment required.

In a country where summer tourists are numerous there is particular need for suitable transportation, which is too frequently absent at present. Inaccessibility is a serious obstacle in developing the summer business and it often happens that regions in themselves most attractive are cut off by lack of the railway facilities which would make them practicable. For such cases the light electric railway has many advantages, since it can be put down at a cost that allows a profitable business even if the bulk of it has to be crowded into the summer months. A very natural question which will be raised is: "why do you talk light railways, what is the matter with an ordinary electric road cheaply installed?" The answer is this: "it is almost impossible to start with the idea of a cheap road using standard equipment and to carry it vigorously through to the end. Some one gets enthusiastic over the chance of an extension, or the possibilities of rapid growth, and weakens to the extent of putting on heavy standard cars. This implies a heavier track if the cars are to run well, strengthening of bridges and trestles, a bigger feeding system, a little more generating capacity, a cut-off to save time over the natural route along the highway, and before the trend of these things is fairly recognized the project has risen to double its proper cost. A cheap, even, narrow-gauge road that pays is worth two standard roads in the hands of receivers, as an investment. "But," some one says, "how can such a road exchange cars with standard roads?" On the other hand, who asked it to do so? These little rural lines should stand strictly on their own merits as practicable enterprises. Most of them should go in where the very absence of connections and the improbability of getting any is the very reason for their being. They should occupy ground where they are needed with the clear understanding that they are just what they claim to be—rural roads to meet rural needs, without any probability of ever being part of a trunk line. They are essentially enterprises to be put through, largely by local interests, forming the capillaries of traffic circulation. How far it is wise to go in the matter of lightness is a proper subject for experiment as the roads go in. In a general way one may safely say that they should be kept down to about half the ordinary cost of electric roads in open country. On this basis they can not do all that an ordinary road can do in speed and capacity, but they can do all that is required to earn dividends, and that is what some standard roads fail to do. If they are intelligently installed in carefully selected districts every light electric road can do admirable work, and that the need of them is real a brief trip with one's eyes open will demonstrate.

International Association of Municipal Electricians.

The tenth annual convention of the International Association of Municipal Electricians will be held at Erie, Pa., August 29, 30 and 31, 1905. At this meeting will be presented the following papers:

"Electrical Induction, Its Effects and the Application of Methods Used to Counteract It."

"Advisability or Inadvisability of Fusing Fire and Police Telegraph Boxes."

"Suggested Improvements in Fire Alarm Telegraphs."

"Underground Construction."

"The Necessity of a Rigid Inspection by the Municipality."

"Electric Light Engineering."

"Electric Light Plants."

These papers have been assigned to men who are thoroughly conversant with the subjects selected, and they are of great importance to the municipal electricians. Frank P. Foster, of Corning, N. Y., is secretary of the association.

HIGH-PRESSURE LINE CONSTRUCTION FOR ALTERNATING-CURRENT RAILWAYS.[1]

BY THEODORE VARNEY.

The chief advantage to be derived from the direct application of the alternating current to railway service is in the use of high trolley pressures. Having a successful alternating-current motor, the remaining problem of greatest importance is the method of supplying current to the car. The third rail, which is largely used in heavy railway work, is obviously unsuited for carrying 3,000, 6,000, or 10,000 volts on the score of insulation and of safety. Moreover, the third-rail construction, whatever be the pressure, is not suitable for terminal yards in which there are many tracks and in which derailments are not unusual. A smash-up would be almost certain to result in tying up the system.

Of the various methods of current supply heretofore employed the overhead conductor is believed to be the only one capable of development into safe or permanent operation with trolley pressures running up into thousands of volts. The present paper will describe some preliminary work which has been carried out on a practical scale with overhead conductors. In laying out a suitable overhead high-pressure alternating-current system, it was decided to make a radical departure from the present methods of construction wherein the insulation is made only good enough and the supporting structure only strong enough to keep the cars running by the aid of an efficient repair department. It was rather the aim to obtain a system which would be serviceable and reliable for several thousand volts and which when once in place would at least equal in durability and cost of maintenance the bridges, track, and other portions of a standard railroad. While the exacting conditions and heavy traffic of the present steam roads will require for successful operation by electricity a carefully planned and substantial construction, the lighter interurban roads may frequently be equipped with a less expensive system.

Several classes of construction have been designed; of these the least expensive type employing bracket arms will be described first.

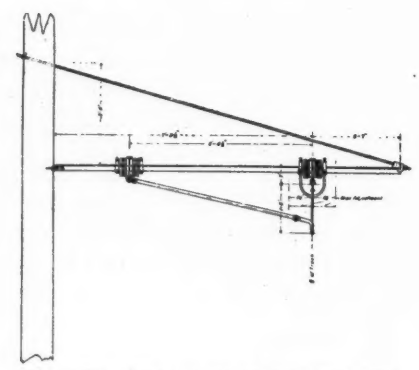


Fig. 1.—T-Iron Bracket with Main Insulator and Steady Strain.

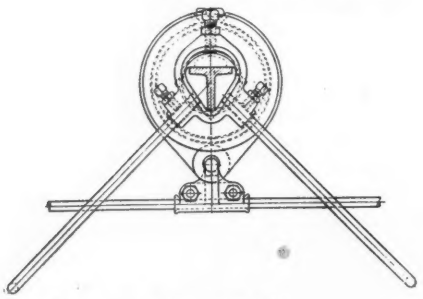


Fig. 2.—Single Catenary, Main Insulator Details.

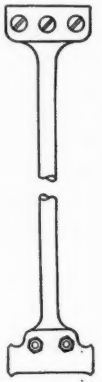


Fig. 3.—Hanger made in Six Lengths.

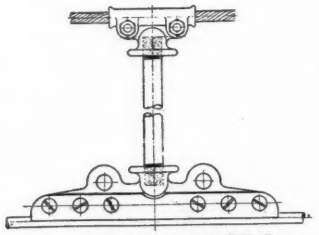


Fig. 4.—Single Catenary, Curve Pull-off.

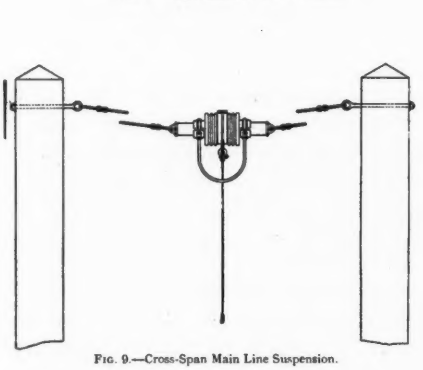


Fig. 9.—Cross-Span Main Line Suspension.

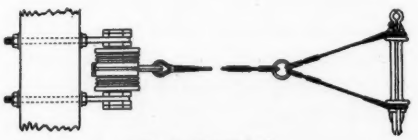


Fig. 5.—Curve Pull-off.

Fig. 6.—Anchor Scheme.

Fig. 7.—Anchor Scheme.

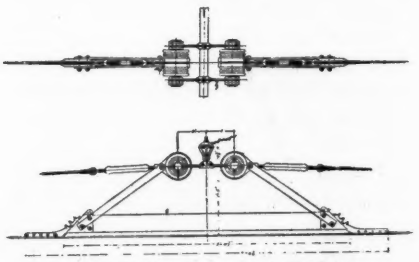


Fig. 8.—Single Catenary, Section-break Insulator.

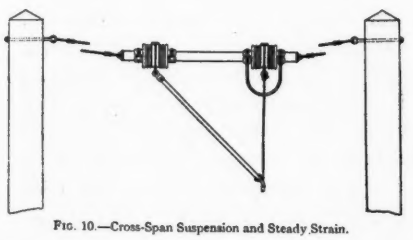


Fig. 10.—Cross-Span Suspension and Steady Strain.

LINE CONSTRUCTION FOR ALTERNATING-CURRENT RAILWAYS.

BRACKET-ARM CONSTRUCTION.

This system consists of a single line of wooden poles spaced well apart and fitted with bracket arms and steel catenary sus-

[1] A paper presented at the 195th meeting of the American Institute of Electrical Engineers, New York, March 24, 1905.

pension cable for supporting the trolley wire. The bracket arm is a T-iron supported by a tension rod at its outer end and fitted at the inner end with lugs which partly embrace the pole and to which they are bolted with lag screws. Fig. 1 indicates the construction.

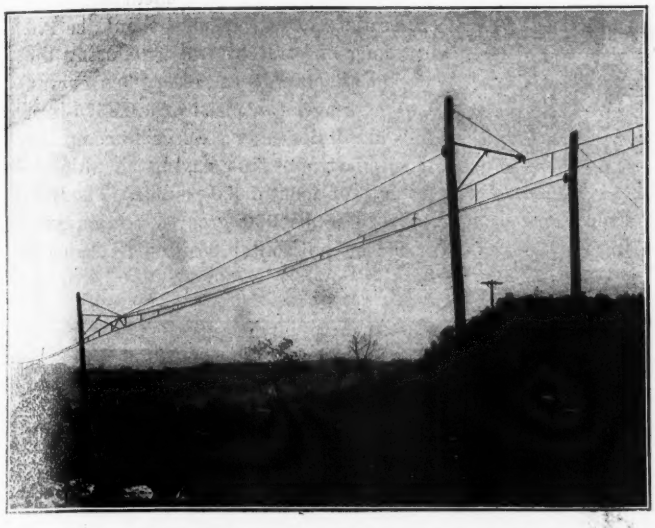


FIG. 11.—SINGLE CATENARY, 120-FOOT SPAN AND ANCHOR.

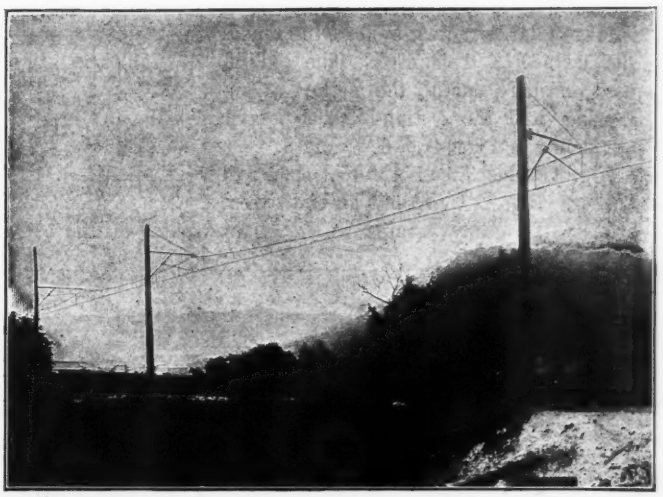


FIG. 12.—SINGLE CATENARY, 80-FOOT SPAN WITH STEADY STRAIN ON CURVE.

The insulator is of corrugated porcelain, cemented to a malleable-iron sleeve which in turn is slipped over the bracket arm and held by clamps and set screws. The porcelain insulator has a groove at its centre surrounded by a malleable-iron collar similar to a pipe clamp. This collar has an eye on the lower side into which the hooks of a clamp which carries the steel supporting cable or messenger are inserted. Wheel trolleys will probably be used to a considerable extent with the lower pressures. Guard loops are provided to prevent breakage of the porcelain, in case the trolley should leave the wire under a bracket. The insulator with its fittings is shown in detail in Fig. 2.

The guard loops are also of service in temporarily supporting the cable while it is being run out and pulled up. The trolley and messenger are run out together, and the former is supported from the messenger at occasional points by temporary tie-wires. The tension in the messenger cable is adjusted to give the proper sag, and the trolley wire is pulled up tight enough to take out all kinks and bends. Both trolley and messenger are then anchored. The messenger is next clamped to the insulators and the trolley is permanently supported from the messenger by means of hangers or clips which are adjusted in length in such a manner as to hold the trolley horizontally. By this means, the tension in the trolley is slightly relieved and allowance is made for expansion and contraction. The hangers are stiff and, being placed only ten feet apart, correct any tendency of the grooved trolley wire to twist. This ensures that the smooth lower surface will always be downward, a feature especially necessary when bow or sliding trolleys are used. The short distance between hangers also prevents the end of a broken trolley wire from coming dangerously near the ground.

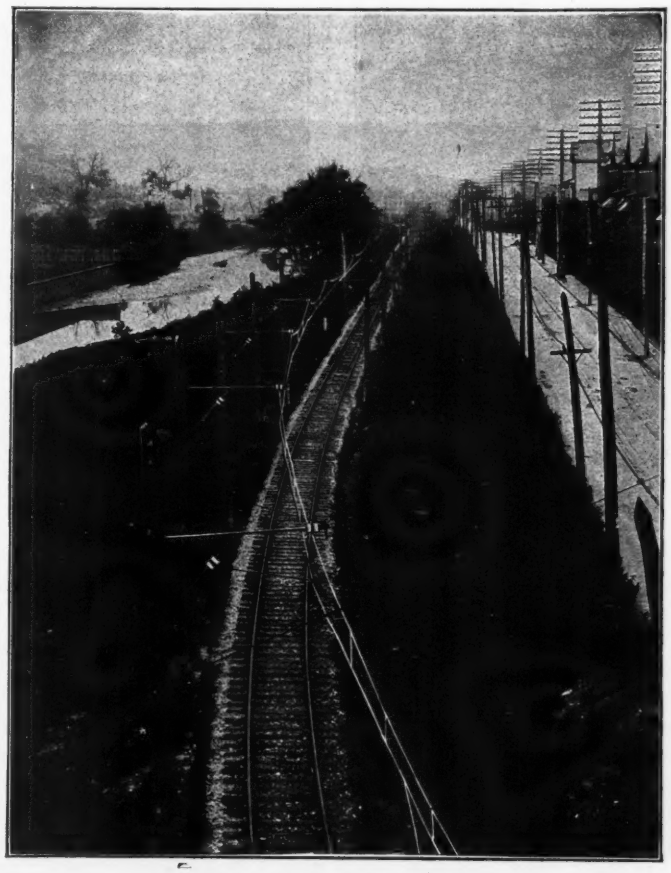


FIG. 13.—SINGLE CATENARY CURVE, SHOWING USE OF STEADY STRAINS.

The method of supporting the messenger below the bracket arm enables a tension rod to be attached to the outer end of the bracket without the necessity of fishing the messenger cable over the arm and under the brace. The cable and trolley may be run out along the track and pulled up in place under the brackets with a minimum amount of labor. Another advantage in this arrangement is the slightly flexible character of the point of support of the messenger; this is not sufficient to permit any considerable vibration of the span as a whole, but will allow any small vibration set up by the trolley to pass on. It has been noticed in rigidly supported spans of considerable length that a tendency exists for waves to be reflected from these fixed points which, when they reach the trolley, lift the wire from it, thereby causing flashing.

The hanger is illustrated in Fig. 3 and consists of a galvanized malleable-

iron casting made in ten lengths. It is fitted with a bolted clamp to take the messenger cable and is secured to the trolley with screws. At intervals of about 1,000 feet and upon curves of large radius, a steadying device shown in Fig. 1 is used. The pull-off used on sharp curves, the method of anchoring, and the section-break insulator are shown in Figs. 4, 5, 6, 7, and 8.

Fig. 11 illustrates a 120-foot span and anchor. Fig. 12 represents an eighty-foot span with steady strains on a slight curve. Fig. 13 is a view taken from an overhead bridge, showing the use of steady strains on a moderately sharp curve.

MEASUREMENTS ON SPANS IN SERVICE.

A road five miles in length has been in operation for about five months, and upon this road several forms of construction have been installed. One portion has been equipped with 120-foot spans with sags of twenty-four inches in the messenger cable. Another section has spans of about ninety-six feet and sags of about four inches. In the latter case both messenger and trolley wire are tighter than the former. The effects of temperature upon these two forms of construction are indicated by the following observations during the period of two months:

Date.	Temperature Fahr. Degrees.	Height of Trolley Wire above Rails.	
		Span No. 1.	Span No. 2.
		120-ft. Span.	
12-22-04	33.8	21 ft. 3.4 in.	21 ft. 5.1 in.
12-23-04	52.3	21 " 2.0 "	21 " 3.6 "
1- 4-05	16.0	21 " 4.1 "	21 " 5.5 "
		96 ft. Span.	
12-22-04	34.7	20 ft. 7.0 in.	20 ft. 7.5 in.
12-23-04	52.3	20 " 6.8 "	20 " 7.4 "
1- 4-05	14.7	20 " 7.4 "	20 " 7.9 "

The greatest temperature variation noted on the 120-foot spans was 36.3 degrees Fahrenheit, and the corresponding changes in height at the centres of the spans were 2.1 inches and 1.9 inches respectively.* For the ninety-six-foot spans the temperature variation was 37.6 degrees and the corresponding changes in height were 0.6 inch and 0.5 inch respectively.

The combined weight of messenger, 000 trolley wire, and hangers averages one pound per foot which gives a tension in the messenger cable with 120-foot span and twenty-four-inch sag of about 900 pounds. The tension with ninety-six-foot span and four-inch sag is about 3,500 pounds.

BEST ARRANGEMENT.

For best results with this form of construction both as regards cost and operation, the following arrangement is considered satisfactory: the spans should be 120 feet long on straight track, reducing the length as may be necessary on curves. The messenger to consist of a 0.4375-inch galvanized Bessemer steel cable composed of seven strands and having an ultimate strength of about 6,000 pounds. The trolley wire to be 000 grooved section supported in horizontal position by hangers placed ten feet apart. The messenger cable is to be pulled up to a minimum cold weather sag of about eleven inches, corresponding to a tension of about 2,000 pounds.

CROSS-SPAN CONSTRUCTION.

For conditions where bracket arms can not be used, cross-span work may sometimes be employed. For this purpose the arrangement indicated in Figs. 9 and 10 has been designed. The difference between this arrangement and the bracket-arm construction is the substitution of a 0.4375-inch steel span cable for the bracket. Other details are practically the same.

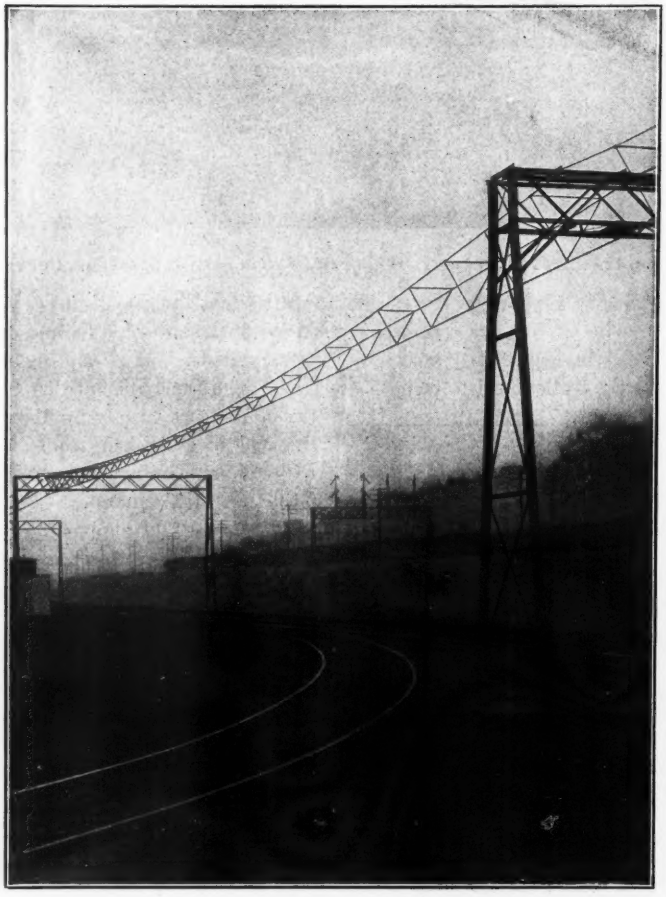


FIG. 14.—DOUBLE CATENARY, BRIDGE CONSTRUCTION.

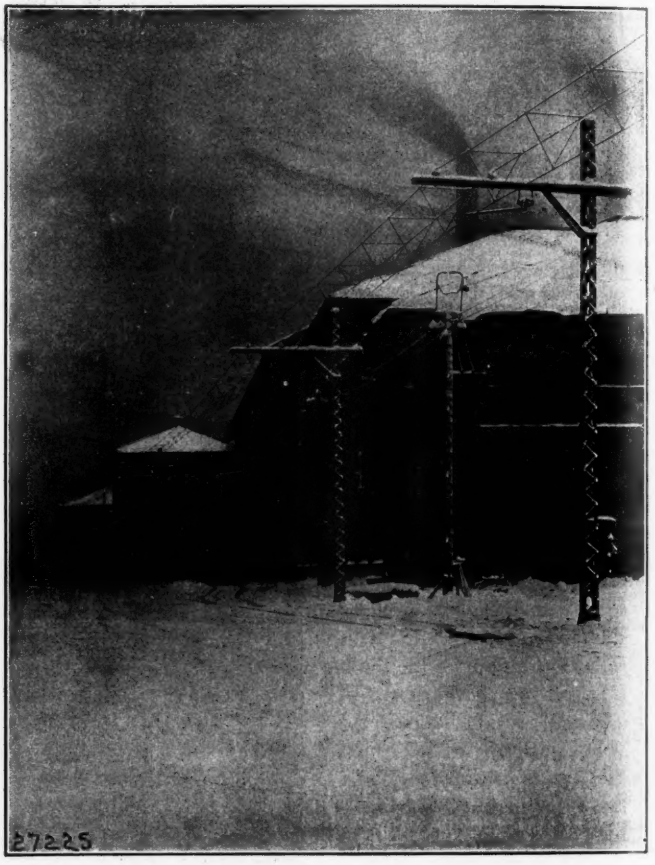


FIG. 15.—DOUBLE CATENARY, LATTICED-POLE CONSTRUCTION.

BRIDGE CONSTRUCTION.

For the heavy service requirements of steam roads having from two to four tracks, the construction described above is not adequate; a more substantial equipment and one which will not encroach upon the present standard clearances is necessary. Obviously, the best form of support to accomplish this result is a bridge long enough to span all tracks with ample clearance on the sides and overhead, and stiff enough to carry all of the overhead conductors without undue vibration. Bridges of this character are at present in use on many roads to support semaphores and other signal apparatus.

Fig. 14 illustrates a section 2,500 feet long of a three-track road, one track of which has been equipped with the bridge construction. The double catenary system is used, each messenger being a 0.4375-inch steel stranded cable. The trolley wire is 000 grooved, and the supporting hangers are placed ten feet apart. The average total weight per foot supported by each cable, including its own weight, is 0.91 pound. The vertical sag in the first span, which is 230 feet long, is 2.6 feet, and in the second span, which is 270 feet long, 3.6 feet, both at 26.6 degrees Fahrenheit. The corresponding tension in the messenger cables is 2,300 pounds.

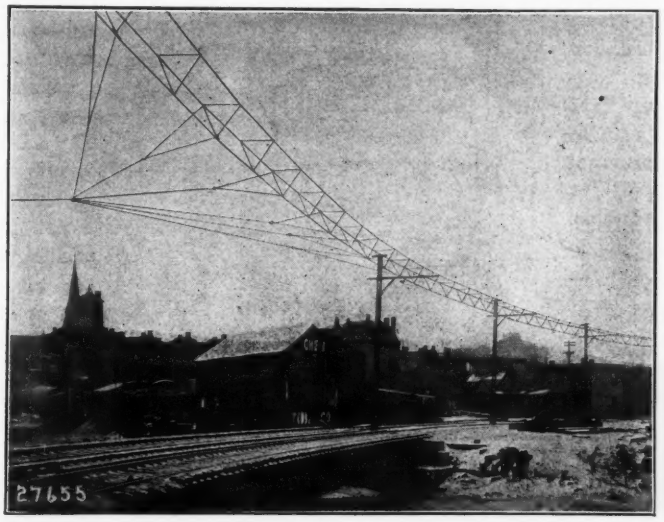


FIG. 16.—DOUBLE CATENARY CURVE WITH PULL-OFF.

The observed variation in height of trolley wire due to temperature change was as follows:

Date.	Temperature Fahr. Degrees.	Height of Trolley Wire above Rails.	
		Span No. 1.	Span No. 2.
1-16-05	26.6	23 ft. 9.1 in.	23 ft. 7.1 in.
1-26-05	6.8	23 " 10.1 "	23 " 9.9 "
2- 9-05	39.2	23 " 7.3 "	23 " 4.3 "

The maximum temperature variation is 32.4 degrees and the corresponding change in height of trolley wire is 2.8 inches for the 230-foot span and 5.6 inches for the 270-foot span.

Fig. 15 shows an extension of the double catenary construction supported upon latticed poles, while Fig. 16 represents a curve of 425-foot radius. In the latter view the use of double catenary curve pull-offs is illustrated.

PROPOSED GENERAL PLAN.

It was first thought advisable to run the messenger cable over the bridges. Fig. 14 shows this construction. It is necessary, however, to provide an unobstructed view of the signal apparatus and it is accordingly considered preferable to make the bridge high enough to permit the semaphores to be suspended below the truss.

Fig. 17 indicates a signal bridge which has been devised for a four-track road carrying besides the semaphores, the four sets of cables and trolley wires suspended below the truss. This construction is a decided advantage in erecting, as the cable and trolley wire can be run out along the track and lifted into place.

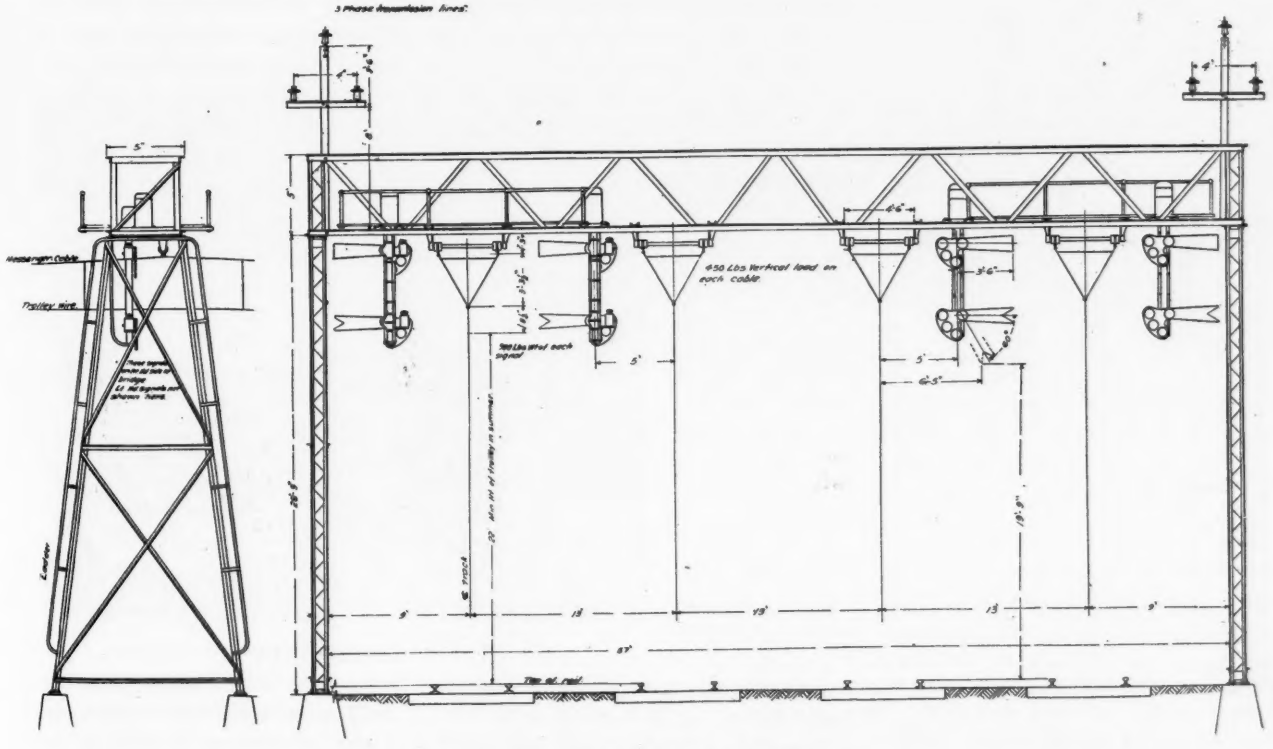


FIG. 17.—SIGNAL BRIDGE FOR FOUR-TRACK ROAD.

Massive porcelain insulators will be used mounted on heavy pipe and fitted with collars having soft lead strips under them. From these the cables will be hung by means of bolted clamps.' By anchoring all cables to the bridges after being drawn up to a uniform tension, the effect will be to steady the bridges. For roads having wide rights of way comparatively light bridges steadied with guy cables may be used, but for most cases a substantial structure similar to those now used for signal towers will probably be preferable. It will be noted, however, that owing to the comparatively long intervals between signals only a few of the bridges carry semaphores; the others may be made lighter than the one indicated in Fig. 17.

Spans of 300 feet for straight tracks appear to be satisfactory, not being so long as to permit undue vibration in the cables, and not so short as to require a large number of bridges per mile.

For the messenger cables 0.625-inch

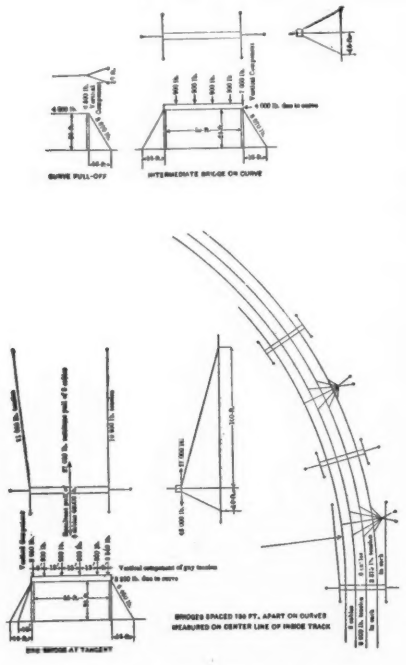


FIG. 18.—CURVE, 500-FOOT RADIUS.

extra high strength steel strands are suitable. With a 0000 grooved trolley wire and hangers spaced ten feet, the average load per foot on each cable is 1.43 pounds, and with a vertical sag of 2.7 feet the tension is 6,000 pounds. In a rough climate, wind and sleet will at times increase this tension; assuming that the tension may be doubled, a factor of safety of about 3.5 will still remain, as the breaking strength of the cable is about 40,000 pounds.

For use in localities where milder weather conditions may be assumed, lower grades of steel may be used having breaking strength for the same weight per foot of 25,000 pounds and 19,000 pounds. These latter cables are somewhat easier to

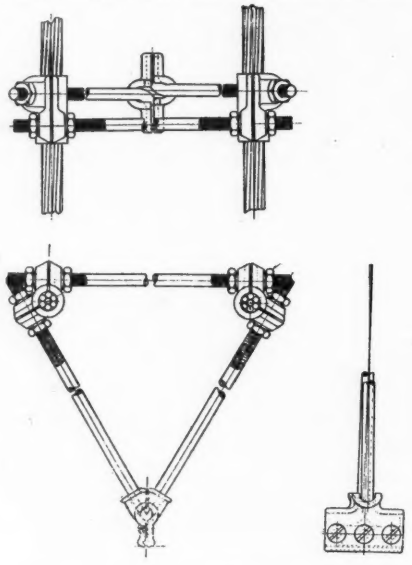


FIG. 19.—DOUBLE CATENARY ADJUSTABLE TROLLEY HANGER.

handle and would be sufficiently strong for most conditions.

The sag given above is taken to be the cold weather condition and for 100 degrees Fahrenheit rise the sag would be about 4.4 feet, or a variation of 1.7 feet. In Fig. 17, this allowance is made in the height of the bridge so that the lowest point of the trolley wire will be twenty-two feet above the track. It is not believed that the variation will be this much on account of the giving of the supports and other causes.

For curves, the length of span will be decreased; and when necessary to hold the wire in the centre of the track radial pull-offs will be used, secured to strain insulators. These will be mounted on latticed poles which in turn will be braced by guy anchors.

For sharp curves, the radial pull of all the messenger cables would be severe, and it is intended to provide at the tangent points anchor bridges which will have trusses stiff enough in the horizontal plane to stand the strain of slacking off the cables about one-half. These anchor bridges will then be held by long guys running out a considerable distance from the bases of the bridges and anchored to cross-ties or channel-irons buried in the ground and concreted. Fig. 18 represents in outline a 500-foot radius curve.

Several details for the double catenary construction are shown in Figs. 19 and 20. All of the metal parts other than the bridges and trolley wire are galvanized, but as a further protection against depreciation from locomotive fumes periodical painting is advisable.

Regarding the efficiency of the insulation employed, it may be stated that under the snow-clad conditions indicated in

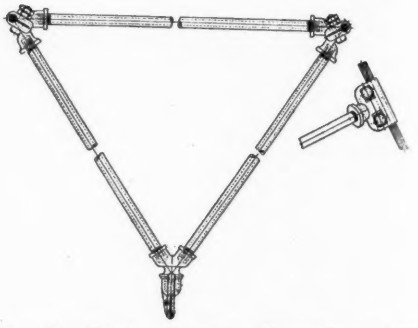


FIG. 20.—DOUBLE CATENARY CURVE PULL-OFF

Fig. 15, the 2,500 feet of iron bridge work and five miles of single catenary construction showed under test a leakage of one ampere at 6,000 volts.

CONCLUSIONS.

The foregoing describes the actual work which has been carried out with a view of

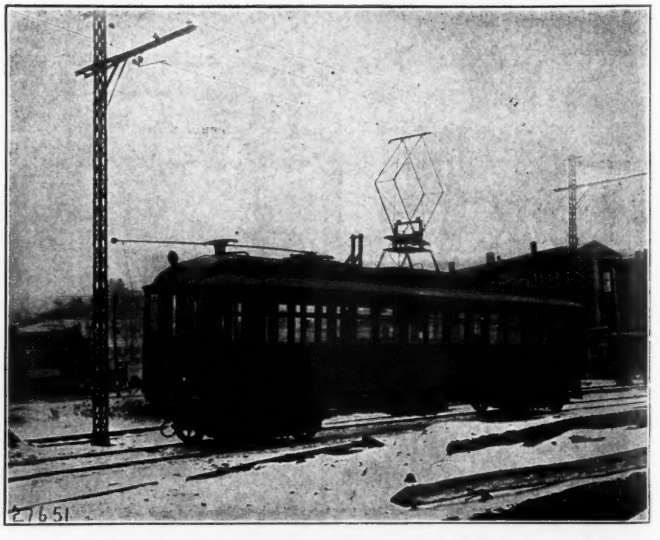


FIG. 21.—HIGH-PRESSURE PANTOGRAPH TROLLEY.

developing a system of overhead conductors for moderate and heavy traction service which will approach in a far greater degree than heretofore the reliability and

permanency of present steam railroad equipments.

Aside from the work described above, forty miles of road using the single catenary wood-pole construction have been put in operation in Indiana. This has been in successful running order since the first of this year. The remaining sixty miles of this road will probably be completed in the near future. The pressure is 3,300.

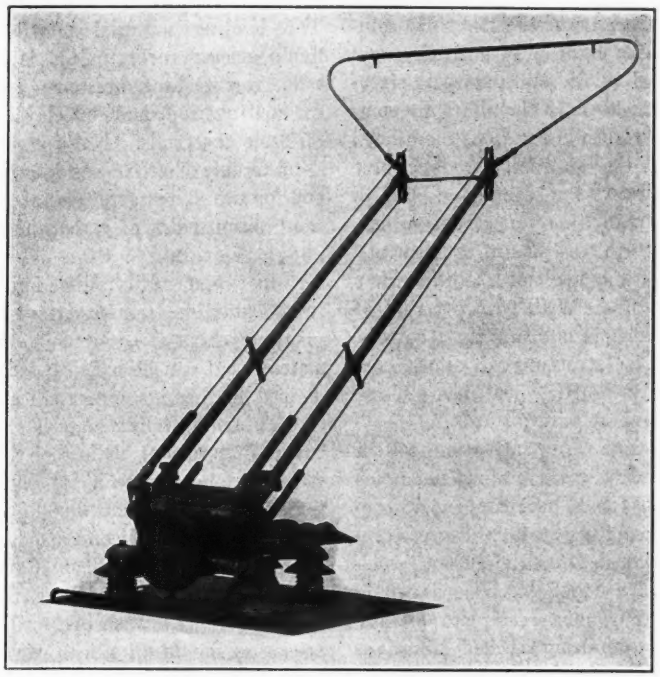


FIG. 22.—SLIDING-BOW TROLLEY.

Fig. 22 is of interest in showing the type of air-operated sliding-bow trolley in use on this road. Another form of trolley with which satisfactory results have been obtained is shown in Fig. 21. It is also air-operated and is insulated for 6,000 volts.

Application of Electricity to Heavy Freight and Trunk Line Railways.

On Tuesday evening, April 18, Mr. J. H. Hallberg delivered an illustrated lecture on the "Application of Electricity to Heavy Freight and Trunk Line Railways" before the Electrical Engineering Society of Columbia, at the Columbia University, New York city.

The lecturer described in detail all electric systems which have been proposed and tried for trunk line service, and a number of lantern slides, illustrating the 15,000-volt single-phase railway developments carried on by the Oerlikon Electric Company, of Zürich, Switzerland, under the direction of Mr. Emil Huber, were the subject of an interesting description and discussion.

The electrical equipment for the New York Central Railroad, now being manufactured by the General Electric Company, was also illustrated by lantern slides, and an enthusiastic discussion followed the description of this system.

Mr. Hallberg also had prepared for the occasion a number of special slides, illustrating the Siemens & Halske locomotive, used for the high-speed electric railway tests between Marienfeld and Zossen, and others, showing in diagrammatic form the power and distribution equipments required for the various systems.

One of the most interesting subjects discussed during the evening was the single-phase to polyphase electric railway system which has recently been invented by Mr. Hallberg, and which has already been described in the electrical press. The important feature of this system is that it is possible to build very powerful locomotives which can be operated with only one contact wire delivering high-voltage single-phase current to the locomotive, on which the current is then converted by means of a motor-generator set into polyphase currents suitable for the polyphase induction motors, which are mounted on the driving axles.

As all generating and transforming apparatus are of the alternating-current type, no commutators will be required, and the use of induction motors on the locomotive eliminates altogether the use of commutators for any of the main generating or driving machines for this system, and which was considered an important feature.

Considerable attention was also given to the various forms of construction for overhead contact wires for high-speed trunk line railway service, and the inverted catenary construction developed by Mr. Huber of the Oerlikon company was favorably commented upon, and the general opinion was that it would be preferable to make contact on the top of the contact wire, as suggested by Mr. Huber, instead of using the ordinary catenary suspension, which makes it necessary to collect current from the underside of the contact wire.

The speaker also agreed with Mr. C. O. Mailloux and Mr. Damon in that nothing less than 15,000 volts should be used for heavy trunk line traction, and it was also thought that the use of more than one wire for each track would be prohibitive. In other words, the straight three-phase system, requiring either two or three trolley wires for each track, would not be considered as a general proposition.

Mr. Hallberg also commented favorably upon Mr. Mailloux's suggestion to generate current at about 15,000 volts, which could be distributed directly to the contact wire wherever necessary, instead of generating current at a low voltage and then stepping up to a very high voltage for the transmission lines and again reducing the pressure at substations for the contact wire. Where large amounts of power are generated, as for a large trunk line railway system, it would perhaps be more economical to generate and distribute directly to the contact wire without the use of high-potential transmission lines and substations.

Professor Fitzhugh Townsend took active part in the discussion, and several interesting references were made by him to the bipolar motors designed by the General Electric Company for the New York Central locomotive, and he explained very clearly why those motors operate under greatly varying loads and other unfavorable conditions without sparking. He also pointed out several advantages of Mr. Hallberg's single-phase to polyphase railway system.

Mr. Karl Wersall, an electrical engineer, until recently in the employ of the Oerlikon company at Zürich, also participated in the discussion, and he pointed out several of the advantages of the Huber inverted catenary contact-wire support, and he also referred to the sucessful operation of the Oerlikon 15,000-volt single-phase locomotive, which is equipped with the Ward-Leonard system of control, and which has been in daily successful operation during the past few months on a section of the state railways in Switzerland.

The Faraday Society.

The thirteenth ordinary meeting of the Faraday Society was held on Tuesday, April 4, 1905, at the Institution of Electrical Engineers, London, England, Professor A. K. Huntington being in the chair.

Mr. A. H. Hiorns read a paper entitled "Alloys of Copper and Bismuth." The reading was illustrated by lantern slides of the photomicrographic observations referred to in the paper.

This is further research on copper alloys carried out in a similar manner to that on the copper-arsenic series published in the Transactions of the Society, April, 1904.

Professor Arnold has investigated the effect of bismuth, from 0.1 to 0.5 per cent, on copper, and found that the investing membranes surrounding the grains of copper appeared to be split down the centre, presenting a definite plane of cleavage. Dr. Gautier obtained a freezing-point curve similar to the author's but his temperatures are generally higher.

The microscopic evidence mainly confirms the records of the freezing-point curves, of which there are four branches. We have pure copper and pure bismuth at the extremes, and solid solutions of copper in bismuth or bismuth in copper at intermediate points. The types of pattern on the etched surfaces depend on the position of the freezing points on the curve. The eutectic points occur at 243 degrees centigrade and 1,020 degrees centigrade, with a transition point at 858 degrees centigrade. From this point with increase of bismuth in alloys containing thirty to forty-three per cent of copper, the curve is practically a horizontal line showing little differences in the freezing points. In the region two possible chemical compounds may be present, *viz.*, Cu_3Bi_2, and Cu_2Bi, but there are no well marked indications of such, either in the freezing-point curve or in the microsections. Such compounds can therefore only exist in contact with solutions containing excess of bismuth.

The above mentioned transition point is the transition point between solutions of copper in bismuth and bismuth in copper, and at this point the two solutions have probably the same freezing points, each being lowered by the addition of the other, thus forming a conglomerate of the two mixed crystals, which here exist in equilibrium.

Copper, with small percentages of bismuth, consists of polygonal grains, the boundaries of which contain a thin line of bismuthide. When such copper is broken the line of fracture follows this line. With two per cent bismuth the surface shows a characteristic eutectic structure. With increase of bismuth gradually widening boundaries to the grains appear and the interior is of a eutectic nature, which also increases with the addition of bismuth. With seventy-five per cent bismuth the whole surface is composed of grains of the two solid solutions, one of a light gray and the other of a light red color. With sixty to sixty-seven per cent bismuth the alloys are composed of the two solid solutions mentioned above, with the addition of dark blue grains, probably the compound Cu_2Bi. With seventy to ninety per cent of bismuth there are two main constituents, consisting of the red solid solution in a eutectic mixture. With 97.2 per cent of bismuth the whole is decidedly a eutectic mixture. The structure of alloys containing ninety-eight per cent bismuth and upward resembles pure bismuth.

The chairman drew attention to the fact that previous observers had not noted the eutectic point of pure copper and copper bismuth solution at 1,020 degrees centigrade, shown at D on the author's cooling curve. He hoped Mr. Hiorns would make his study more complete by systematically examining chilled alloys as Heycock and Neville had done in the case of the copper-tin series.

Dr. C. H. Desch remarked that the photograph of the 0.4 per cent bismuth alloy was the best that had yet been published.

Professor E. Wilson thought that a further study of the 0.4 per cent alloy might throw some light on the well-known influence excited by bismuth in the conductivity of copper.

Mr. Hiorns, in reply to the chairman, said that repeated experiments justified his belief in the existence of the eutectic at 1,020 degrees centigrade.

The discussion was taken on the paper by Mr. E. Kilburn Scott, entitled, "Refractory Materials for Furnace Linings," which was read on January 31 last.

The requirements of a good refractory material are as follows:

1. It should be a poor conductor of heat.

2. It must be mechanically strong over a wide range of temperatures.

3. It must stand the reducing action of the charge; particularly of carbon.

4. If used in an electric furnace, it must be a non-conductor, even at high temperatures.

Refractory materials are classified as follows into four groups. The paper deals with the second and third groups, and particularly with the use of electric furnace products as furnace washes over ordinary linings.

1. Carbon; for the highest temperatures.

2. Silicon carbides.

(*a*) Carborundum (Crystallized Silicon Carbide, SiC)—This has established an excellent reputation as a furnace wash. The binding material mixed with the finely ground carborundum is silicate of soda, for washing ordinary firebrick, or for coating iron, and fire clay in the case of basic materials. Nothing but carbon —preferably charcoal—is known at present for use at temperatures above the decomposition point of carborundum.

(*b*) Siloxicon (SiCO)—This is to a certain extent self-binding, but it is best to add alumina, and in certain cases non-alkaline clay, if desired to make up articles that can be baked before use, and if used for linings, either silicate of soda or coal tar as binding materials; it is then baked in position. Siloxicon is very refractory, and inert in its chemical action. It decomposes at 3,000 degrees centigrade, forming silicon carbide.

(*c*) Amorphous Silicon Carbide—Being a fair conductor of heat, this is best used merely as a wash over ordinary firebricks, as should all silicon carbides. The best binding materials to use are glue, sodium silicate or gas tar, according to circumstances, or the particles of carbide may be fitted together by surface oxidation.

3. Crystallized Magnesite—Ordinary calcined magnesite brick is now recognized as the best material for lining basic open hearth furnaces, cement kilns, etc., on account of its durability, freedom from moisture and silica, and resistance to corrosion. The native magnesium carbonate is usually calcined in a kiln, but the temperature is insufficient to shrink it thoroughly. The paper describes experiments made by the author in shrinking magnesite in some calcium carbide furnaces at Meraker, in Norway. It was possible simply to pass the magnesite down the chutes in the same way as the raw materials for making carbide of calcium. After a two hours' run with 3,500 amperes at sixty-five volts a block, about fifteen inches cube, was obtained, which was practically pure crystallized magnesia. Thus to make three hundredweights of crystallized magnesite took about 300 horse-power for two hours.

It has now been tested as a wash over the firebrick lining of a carbide of calcium furnace, and it was found that the bricks lasted for two hundred hours with-

out repair, whereas the unprotected bricks required repair after a five hours' heat. The author is of the opinion that the crystallized material, without further preparation than being crushed to suitable dimensions, will prove of special value as a refractory material in metallurgical practice.

4. Ordinary firebricks, for the lower range of furnace temperatures.

Mr. H. N. Dains (communicated) gave some comparative analyses showing the differences between Indian, Grecian, Styrian and American magnesites. The great refractoriness of the first was due to the small amount of impurities it contained. Magnesite shrunk in the electric furnace certainly gave the most satisfactory results and in support of this contention he quoted several striking instances. The principal use of burned magnesite was for lining open hearth steel furnaces, converters, rotary kilns for cement manufacture, furnace hearths, crucibles, and refractory bricks. The power consumption given by the author was incorrect, because the experiment quoted was carried out on lightly calcined magnesia that had been lying about and had taken up about twenty per cent of CO_2 and water.

Mr. F. Gelstharp (communicated) said that if a material could be found to withstand the action of tri-silicate of soda and lime at high temperatures, and at the same time would not oxidize, it would be a great boon to glassmakers. None of the materials mentioned by the author was suitable for the port-holes of tank glass furnaces.

Mr. W. Murray Morrison hoped the author would furnish them with further more exact data regarding the temperatures the various refractory materials could stand, their mechanical properties and their heat conductivities. Tar was the best binder to use for high temperatures, and the increase of conductivity it caused was unimportant; but something that would help the refractoriness of the material would be preferable.

Mr. L. Gaster said that a siloxicon wash was insufficient for lining cement kilns, for example; hard bricks of the material were necessary.

Mr. R. Cremer found, after much experience, that silicate of soda was a perfect binder for carborundum. He considered carborundum as good a refractory material as any that had been described, and its mechanical properties were excellent.

Mr. R. S. Hutton said that if magnesite were calcined in an electric furnace the CO_2 given off would rapidly consume the electrodes. But there was another "shrinking" in the sense of increasing the specific gravity, and to this true shrinkage the valuable properties of magnesite (as of quartz) were due; this was the best effected by fusion in an arc furnace, and Moissan had obtained a magnesite of specific gravity 3.654 in this way. In the author's experiments the magnesite was never more than in a semi-plastic condition; magnesia was easily melted in the electric furnace at something above 2,000 degrees centigrade. Electric furnaces, contrary to what had been said, did not require such highly refractory linings as ordinary furnaces, because the material itself should be the effective lining. More information on the thermal conductivities of these materials was needed.

Mr. R. S. Hutton and Mr. W. H. Patterson contributed a paper entitled "Electrically Heated Carbon Tube Furnaces" (part i).

This type of furnace seems to be the most readily available for the very highest temperatures, and the authors have been able to get satisfactory results with a very simple type of construction. The important points to bear in mind are the end-connections (which must be kept cool), protection of the tube from contact with air, and heat insulation. Two types of furnace are described.

1. Graphite Tube Furnace—This is bored from a solid rod of Acheson graphite and screwed into graphite plates which form the end-connections, the latter being clamped to copper holders. The central thinner portion of the tube is surrounded with carborundum or other heat insulator, and the material to be heated is placed in small carbon boats. In a 1.5-centimetre tube (internal) 320 amperes at 9.6 volts melt platinum in sixteen and one-half minutes.

2. Agglomerated Carbon Tube Furnaces—These are more suitable than the former type when much experimental work has to be done, and the tubes can be readily obtained. The ends of the tubes (which are too hard to be worked) are coppered electrolytically and soldered to copper tube extensions provided with water-jackets to keep the joint cool. Into these the current is led by copper clamps, and glass tubes for the passage of gases, etc., are connected by means of rubber stoppers. Carborundum kept in place with an external asbestos tube serves as the jacketing material, as before. Tube furnaces up to sixty-seven millimetres internal diameter have been successfully made. It is hoped to use these in a vertical position, so that large crucibles may thereby be heated. In such a tube 850 amperes at thirteen volts melt nickel in twelve minutes and platinum in twenty and one-half minutes.

In a special tube furnace for experiments in atmospheres of pure gases (free from carbon monoxide), the furnace proper is surrounded by an outer jacketed carbon tube, also provided with water-cooled copper extensions, and the joint between the two is gas-tight. Hydrogen is passed through the space between the tubes.

In a later paper full details as to current and temperature measurements will be published.

Mr. L. Gaster remarked on the ease with which graphite can be machined.

Mr. A. H. Hiorns hoped to adopt some of the valuable suggestions given in the paper in his own laboratory.

Mr. W. Murray Morrison considered that the water-cooled terminals were a great advance on previous modes of construction, and brought small electric furnaces within the scope of almost any laboratory. The ease of regulation in the author's furnaces was another noteworthy feature.

Mr. F. Hiorth drew the attention of the meeting to the wonderful natural facilities which his country (Norway) offered for the development of industries in which the electric furnace was an all-important factor.

The Century's "Great Inventions" Series.

The May *Century* will contain the story of "The Arc Light," by Charles F. Brush. This is the first of a series of papers on great inventions, described by their inventors. Mr. Brush gives in detail the history of arc and incandescent lighting, his own early experience and experiments, the beginnings of public lighting by electricity, the growth of the industry, and the organization of the Brush Electric Company.

In early numbers of the *Century* there will be papers on "Electric Traction," by Frank J. Sprague; "The Transmission of Power," by Nikola Tesla; "The Air Brake," by George Westinghouse, and descriptions of two important engineering projects, one of them the Simplon tunnel.

Interurban cars around Pittsburg are equipped with long-distance telephones which may be connected to a wire alongside the track and communication had over the Bell system.

The Application of Electricity in the New York Hippodrome.

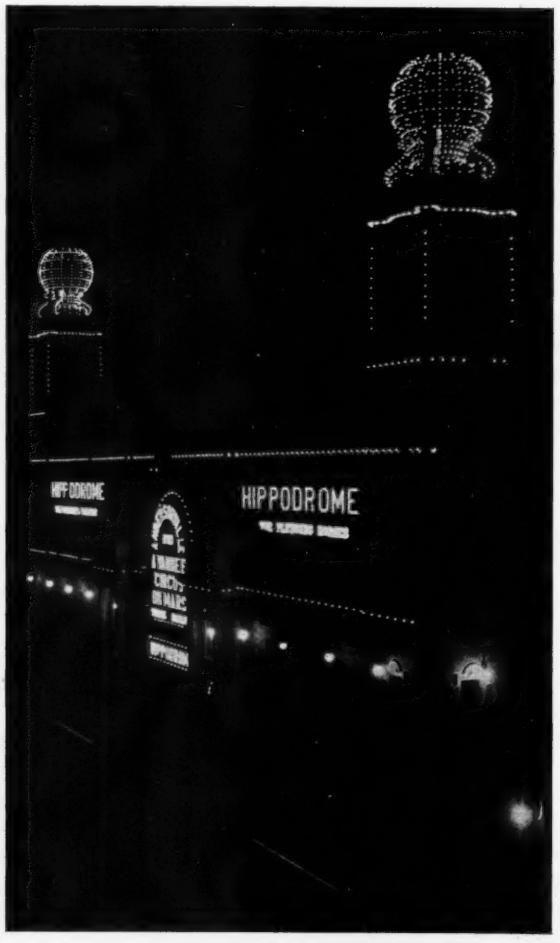
THE New York Hippodrome, which was opened to the public quite recently, occupies the entire block on Sixth avenue extending from Forty-third to Forty-fourth street. The building has a frontage of 200 feet on Sixth avenue, and extends 240 feet east on Forty-third and Forty-fourth streets. It is constructed of brick, marble and steel. The height on Sixth avenue is seventy-two feet, and 110 feet over the stage. The seating capacity of the building is 5,200 persons.

A novel feature of the Hippodrome is the stage. This consists of two portions. Behind the proscenium arch the stage is fifty feet in depth by 200 feet in width between the side walls. The stage extends in front of the proscenium arch for a distance of sixty feet. This portion is known as the apron, and is generally elliptical in form. It has a total width of ninety-two feet.

The portion of the stage immediately behind the proscenium arch is capable of a movement of eight feet vertically. The platform is carried upon four plate girders. At the intersection of the girders are placed four twelve-inch plungers, which may be raised and lowered by hydraulic power. This portion of the stage may be either raised as a whole or in sections.

The movable portion of the stage is provided with counterweights. Sheaves for the counterweights are placed at the top of the steel columns which are used as guides for the platform. The guides are built with a slot in which slide dogs, which may be given a horizontal movement and lock the stage at any desired elevation. The dogs are operated in unison. They are driven by two lines of countershafting extending the entire width of the stage. One of these countershafts is at the forward, and the other at the rear end of the stage. A motor is at the centre of each countershaft, and drives it through a worm gear. The countershaft carries a small pinion at each dog, the pinion engaging with a rack on the upper side of the dog. When the motor is started, the dogs are simultaneously moved to a locking position.

The necessary hydraulic pressure to raise and lower the stage is furnished by a Deane geared, triplex, motor-driven pump, with cylinders three inches by eight inches. The pump is located in the basement under the stage. It is driven through double reduction gearing by a forty-horse-power, 220-volt motor running at 650 revolutions per minute. The motor is controlled by one of the Otis Elevator Company's magnet regulators. The pump delivers water to a pressure tank in which pressure is maintained at 1,000 pounds per square inch by two accumulators. These accumulators consist of massive weights supported on the top of a steel plunger working in a cylinder. They are electrically connected with the magnet regulator, and stop and start the pump.



EXTERIOR OF NEW YORK HIPPODROME AT NIGHT.

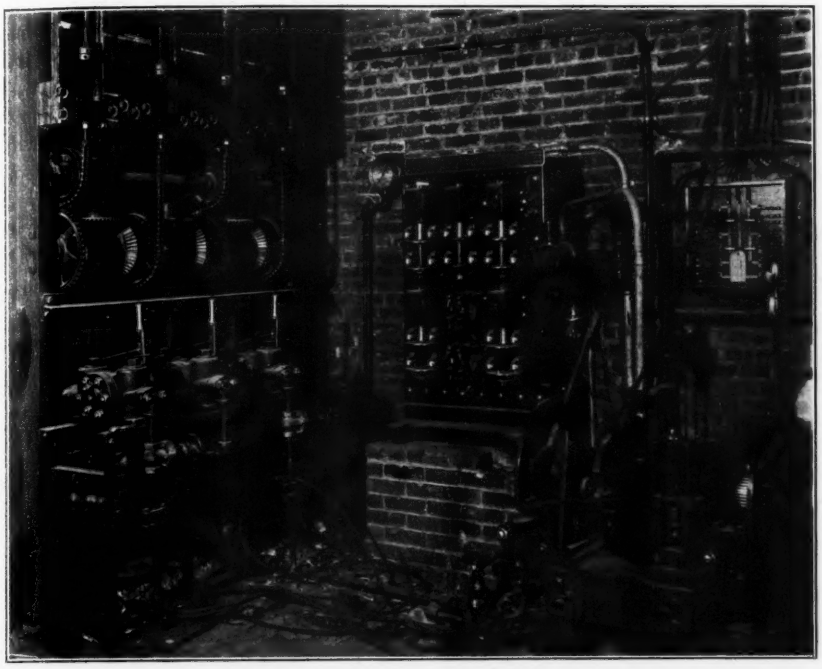
The portion of the stage in front of the proscenium arch also has a vertical movement. Like the other portion, it is carried on twelve-inch plungers, but has a vertical motion of fourteen feet instead of eight. The normal position of the apron will be at the same level as the main stage. Beneath it is built a steel and concrete tank about fourteen feet in depth, and of such dimensions that the apron will readily sink into it. When it is desired to give aquatic performances, the movable apron is lowered to the bottom of the tank, which is then filled with water.

The tank is supplied with water by three centrifugal pumps, which have a combined capacity of 8,000 gallons per minute. These are installed directly under the stage. Two of the pumps are size six, and one is size eight. The size six pumps are direct-connected to C. & C. direct-current motors of eighteen horse-power, running at 620 revolutions per minute, at 230 volts. The size eight pump is direct-connected to a forty-horse-power, 230-volt, C. & C. motor, running at 410 revolutions per minute. The discharge pipe of the size six pump is six inches, and of the size eight pump, eight inches in diameter. All three pumps discharge into a twelve-inch main running to the tank. The motors are controlled by means of Ward Leonard starting boxes, there being two fifteen-horse-power and one thirty-horse-power boxes installed.

In the basement, under the stage, are also installed the fans for ventilating the building. These fans are four in number, and were built by the American Blower Company, of Detroit, Mich. The fans are sixty-six inches in diameter, and deliver air to all parts of the building. Each fan is driven by a twenty-five-horse-power, 230-volt C. & C. motor, running at 585 revolutions per minute, which is belted to the fan. Each motor is controlled by a twenty-five-horse-power starting box furnished by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

There are also in the basement boilers for heating, and other auxiliary machinery. The boilers—two in number—are of 250 horse-power, and operate at seventy pounds pressure. They were built by the Stirling Company, New York city. The boilers are in a vault directly under the Forty-third street sidewalk. Coal is dumped through the sidewalk into a coal bin at one end of the vault, and is wheeled from there to the front of the boilers.

Feed-water is supplied to the boilers by two Deane triplex steam pumps, seven and one-half by five by six inches. The water passes through a feed-water heater before entering the boiler. All the pumps



EQUALIZING AND CONTROL MECHANISM FOR STAGE LIFT, NEW YORK HIPPODROME.

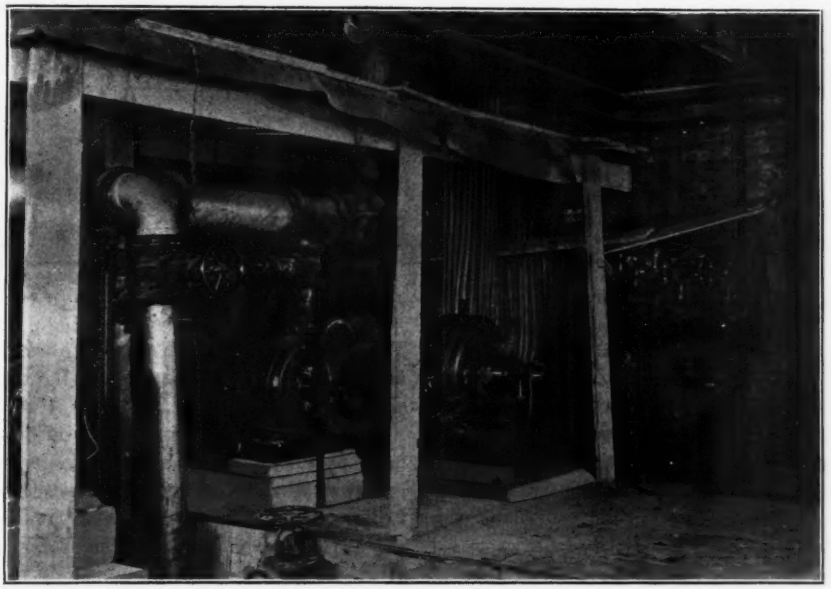
in the house exhaust to the heater, and some live steam is used as well. Besides this heater there is in the boiler room another water heater used for the purpose of heating the water for the house supply. This is run entirely with live steam.

Three other pumps are installed, two of them being used for fire purposes, and one for the house supply. The fire pumps are ten by six by twelve-inch Deane duplex pumps, and are fitted with self-starting pump governors. These pumps deliver water to a 30,000-gallon tank placed on the roof, and also to six four-inch standpipes in various parts of the building. These pipes may also be supplied from the storage tank. Automatic sprinklers are placed in all portions of the building excepting in the café and auditorium, and numerous hose are connected to the stand pipes. The pump in the pump room is a Deane duplex, eight by four by six inches, and is used entirely for the house service.

In the pump room is placed a three-panel switchboard for the Edison service supplying the building. Current is taken from this board to the light and power switchboard on the stage, and also to another switchboard in the pump room, from which all the lights and motors in the basement are controlled.

Electricity is extensively used in the Hippodrome for the handling of scenery. Underneath the gridiron over the stage are four tracks arranged in concentric semi-circles. These run from a pocket behind the side wall on one side of the stage to a similar pocket on the other side. The track is formed of twelve-inch I-beams, upon the lower flange of which run trolley hoists, which are used for handling set pieces of scenery. The hoists are fitted with two-horse-power traverse motors, and one three-horse-power hoisting motor. The traverse motors are each fitted with a drum, around which a cable is wrapped, and are moved by winding up on the cable. All three motors are controlled from the floor by means of pull-ropes operating reversing switches on the hoist.

For lifting the set pieces of scenery there is installed in each of the wings a set of hoists, each of which carries eight winding drums about a foot in diameter. To each set of eight drums there is a three-horse-power, 220-volt Robbins & Myers motor running at 1,350 revolutions per minute. This drives a shaft extending the length of the hoist frame. The shaft of each hoist drum carries a worm-wheel which is driven by a worm on a vertical shaft. On the upper end of this vertical shaft is a paper cone. The horizontal shaft to which the motor is coupled carries two wooden cones at each winding drum, which are located on opposite sides of the cone on the worm-shaft. Either of the cones on the main shaft may be thrown in contact with the cone on the worm-shaft by means of a lever which latches as soon as contact is made between the tow cones. The use of the two cones permits the drum to be driven in either direction. The wire cable which is wound on the drum passes through a slot in the cone-shifting lever. A knob is placed on the cable at such point as it may be desired to stop it. This knob, striking the cone-shifting lever, unlatches it, and it is thrown into mid-position by springs, thus disengaging the friction cones and stopping the hoisting drum instantly. Knobs are placed on the cable so as to stop the drum at the proper point, both in hoist-



MOTOR-DRIVEN CENTRIFUGAL PUMPS, FOR FILLING TANK, NEW YORK HIPPODROME.

ing and in lowering. Each drum is capable of lifting a weight of 800 pounds. There is a total of sixty drums installed. Each bank of sixteen drums is operated by one man. The motors are controlled by Ward Leonard starting boxes placed on panels immediately adjoining the hoists.

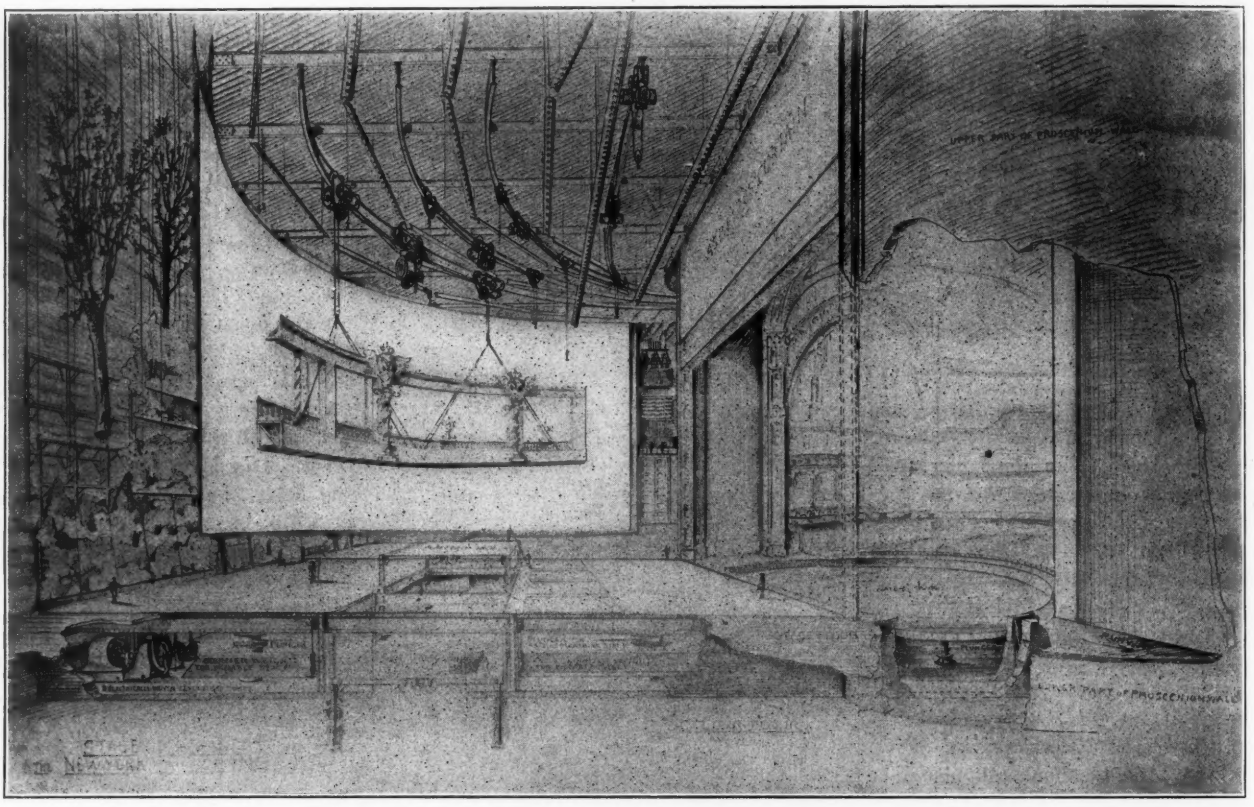
The most interesting portion of the electrical equipment at the Hippodrome, however, is the switchboard for controlling the lights. This is located in one of the wings on a gallery about twenty feet above the floor. The operating board consists of two panels, on which are installed 162 push-button switches. These switches operate solenoid switches on a switchboard in the rear of the operator's board. These solenoid switches were furnished by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Current for the lighting circuits passes only through the solenoid switches, the operator controlling directly only the current energizing the solenoids.

Current for energizing the solenoids is controlled by a separate panel at the left of the operating board. This panel carries a three-pole, single-throw switch, which closes the circuit which controls the current for all the solenoids. The current is taken from this switch to eight other sets of switches, which control various separate banks of solenoids controlling the different colored lights.

On the operating board the push-button switches are arranged in duplicate—that is, there are two sets of switches for each circuit, so that the lights for one act may be set while another act is being performed. In order to prevent interference with the act that is being performed, the push-button switches which are being set are disconnected from the solenoids by one of the sets of switches on the solenoid control panel at the left. When it is desired to throw in the new set of lights, one switch is thrown open on the solenoid control board, and the other is closed. This duplication of the circuits prevents any loss of time in arranging the lighting effects for a given act.

The operating panel is divided into two parts by the dimmer handles. There are two rows of dimmer handles between the two portions of the board, and another row at the top and bottom. The operation of the dimmers is something entirely new in theatre work. On a framework behind the switchboard are mounted four one-quarter-horse-power Holtzer-Cabot variable-speed motors. These motors drive a screw carrying a nut. The nut is connected by a link to a lever on the shaft of the dimmer handles, causing it to rotate as the nut moves either forward or back. On the framework underneath the screw is placed a snap switch which is thrown by the nut whenever it reaches the end of its travel in either direction. This switch cuts the current off from the motor, and thus prevents injury to the dimmers in case the operator neglects to stop it in time. The switch is so arranged that, in cutting off the current from the motor, it throws another portion of the switch in such a manner that the motor is permitted to run in the reverse direction.

Each bank of dimmers controls a set of different colored lights, the colors in use being white, blue, green and red.



Sectional View of Stage, Showing Traveling Scenery Hoists, New York Hippodrome.

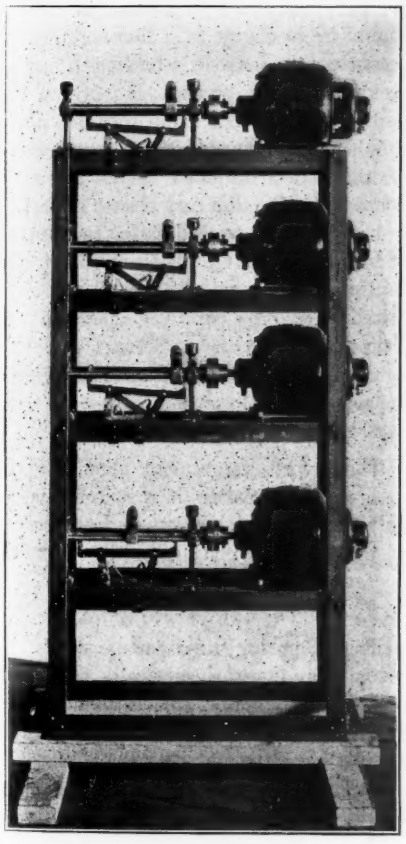
Each dimmer shaft carries a pulley, which is connected by a belt to seventy-six Ward Leonard 200-light theatre dimmers, located in a gallery above the switchboard gallery. These pulleys are controlled by interlocking handles, permitting any circuit to be thrown out if desired.

The motors operating the dimmers are controlled by four Cutler-Hammer starting boxes located on a panel set underneath the lower portion of the light board. The switches for the motors are set on a separate panel over the light board.

At the right of the main lighting board is another panel carrying a number of two

and three-pole switches. These control alternating current which is brought into the building on the Forty-third street side from the service of the United Electric Light and Power Company. This alternating current is used for the miniature lights and for decorative effects. In order to conform to the underwriters' regulations as to voltages for these lights, transformers are installed whenever it is necessary to operate at a low voltage, and the current is stepped down to whatever potential is required.

At a number of different points in the building are placed emergency switches, which control a master solenoid switch on the solenoid board. This switch throws on the glare lights around the proscenium and lights in various portions of the house. In case the operator is driven away from the main switchboard by fire, or otherwise, the house may be lighted from any one of these emergency stations. The current controlled from the emergency stations

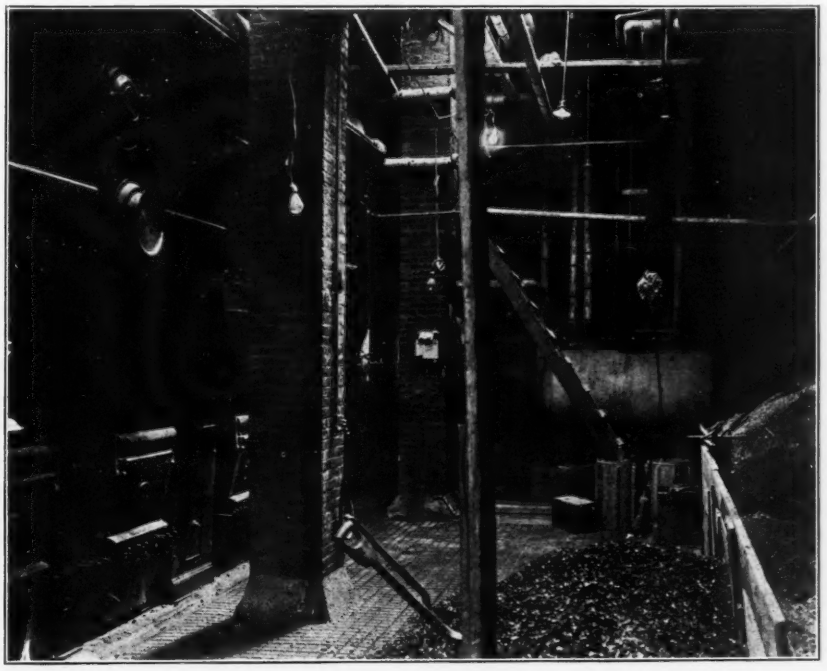


Motors for Operating Dimmers, New York Hippodrome.

is brought into the building from the Forty-third street mains, thus ensuring light at all times in case of an accident to the main supply.

The lighting scheme of the Hippodrome is novel, in that the switchboard is the largest ever employed for operating the lights in a theatre, and also because of the fact that this is the first use of motor-controlled dimmers in New York city. The total number of lights used in the entire building is about 25,000. Six hundred of these lights illuminate two globes located on the towers of the building, and 5,000 are arranged to form a sunburst over the auditorium.

The various portions of the building are connected by means of a telephone system.



Boiler Room, New York Hippodrome.

The prevailing ornament throughout the building is an elephant's head. These heads cap all the pillars, and are placed in every spot where they will be effective in the decorative scheme. The eyes are formed of incandescent lamps and each tusk is tipped with a lamp. A lamp is also placed in the centre of the forehead. Over the main entrance is a large head weighing two and one-half tons, and decorated in a similar manner.

The electrical work in the Hippodrome was done by the Lord Electric Company, Boston, Mass. This company designed the work under the supervision of Mr. Hugh Thomas, chief electrician of the Hippodrome, who is responsible for most of the novel features introduced.

Messrs. Thompson and Dundy, the proprietors of this remarkable enterprise, are justly entitled to the recognition which the public has accorded the Hippodrome. These gentlemen have done much in bringing about an appreciation of entertainment on a magnificent scale. In making use of the most modern agencies in the manipulation of the mechanical devices of the playhouse, and in utilizing so ably the wonderful possibilities of electrical lighting for illumination and decoration, an intensely progressive spirit has been manifested and rare courage shown.

THE PRACTICAL MANAGEMENT OF MAINTENANCE AND OPERATION OF A TELEPHONE EXCHANGE.[1]

BY C. E. STINSON.

The modern telephone exchange is a public necessity, and to so conduct it that patrons will be satisfied and business increase, while at the same time the maximum profit is derived for the investors, requires the closest managerial attention in all departments. The telephone business is a business of details, and no details should be neglected if the business is to be a complete success. To ensure successful management and proper attention to all details, the managerial work should be subdivided into departments, each under a responsible head, working harmoniously toward a common end and directed by a general manager of good executive capacity.

The practical maintenance and operation of a telephone exchange of 9,000 telephones illustrates the metropolitan idea of good service and management. The success of such an exchange, as a public institution and a profitable property, depends upon that attention to detail set forth in what follows.

The organization should consist of the following departments: managers, contract, record, operating, switchboard, wire chief, maintenance and equipment, construction and material, and supplies.

The manager, to do full justice to the

[1] Read before the Ohio Independent Telephone Association, Columbus, March 30.

exchange, should be thoroughly competent to take full charge of the entire operation and maintenance, involving the physical conditions of the property and the respective departments of the company. This is meant in a literal sense. The manager should be an infallible judge of the highest standard obtainable, in the way of maintenance; and he should be able to put that standard into effect in every branch of the business. It goes without saying that the ability to do this means practical knowledge of the most thorough sort. No detail of his department should escape him. He should have at his finger-tips a complete knowledge of the records, material, apparatus and operation; and a thorough understanding of aerial and underground construction and maintenance.

It may occur to you that I am demanding from the ideal manager a collection of almost impossible virtues; but such is not the case. The manager can not personally attend to these multitudinous duties, but he can surround himself with employés in charge of the different departments competent to carry out his ideas and let the authority radiate from him through them. To preserve the highest possible degree of excellence and service in discipline, he should confine his orders to the heads of the departments; trusting to their ability to transfer these orders to other employés.

The manager should look upon himself as being personally responsible to the subscribers of the company. The moment he begins to shift the responsibility for dissatisfaction on to some of his subordinates, that moment does he cease to be in fact, as well as name, the manager of the business. He is the head of the exchange, and as such should feel himself in duty bound to remove every possible cause for complaint against the service.

He should never make a useless rule, but having made a rule which he considers useful and necessary for the best conduct of the exchange, he should enforce the rule at all hazards. A rigid insistence on the observance of such rules need not be the cause of any friction or ill-feeling, whatever, on the part of the employés. If his stand be firm and unyielding—but generous—their respect for him will increase proportionately. Friction between the heads of the different departments is a deadly blow to the discipline of the exchange and should not be tolerated a day beyond the time when its presence is made manifest. The old rule: "I will have peace if I have to fight for it," is a pretty good one to follow, in preserving harmony between the several branches of the business.

If, in addition to this firm adherence to the discipline of the exchange and the steady insistence upon frictionless working between the departments, the manager lets it be known that employés will be promoted as vacancies occur, according to their ability, he will be in a fair way toward the establishment of a perfect organization. If the possibilities of promotion are thoroughly understood, you will find that the majority of the employés will look for promotion and an advance in salary; and as a result take infinitely more interest in their labors and in the affairs of the company. I believe that every department and every position in the exchange should have a fixed salary attached thereto.

The most successful manager is he who assumes that the plant, property and service are always in a condition which permits of betterment. If he will proceed on this theory—constantly preserving a critical attitude toward his own property—the company, the service and the subscribers are bound to benefit by it.

Such an attitude does not necessarily involve a steady increase in the pay-roll. It means rather a constant improvement in the class of employés for the better operation of the system of organization.

The maintenance of the switchboard and central office apparatus is, of course, a vital feature, inasmuch as it is the source of poor service and dissatisfaction to the subscribers. Let us suppose, for instance, that the cords on an operator's position at the switchboard become defective and are allowed to remain so for any length of time: in all likelihood, the manager will receive complaints of poor service; and after an investigation by him (through the proper department), he can only satisfy the subscriber by sending a repair man, change his telephone or wire, or make some other imaginary repairs.

This costs money and does not relieve the situation a particle and the expense incurred would help maintain the cords and remove the cause of the trouble. The very plain moral is: keep up your maintenance and it will increase your earnings and make everybody happy and contented. When your telephone exchange gives good service and is made to work properly, it will pay. This may sound like almost as much of a platitude as the old proverb "honesty is the best policy," but it is true nevertheless. The manager's own selfish interests and the best interests of the company should suggest to him that he satisfy his board of directors or superior officers, that he is seriously and sincerely striving every day and every night, and every minute of every day and every night, to render the company's subscribers the most perfect telephone service possible.

This, of course, can only be accomplished with a proper system of maintenance and operation. He must leave nothing undone that should be done; he must watch the individual department expenses and pay-rolls, overtime, light, heat, power, car fare, and all the other small expense items which usually go to make up a large maintenance account. Everything in the way of material and supplies should be standardized, for that is unquestionably an important saving in the cost of maintenance.

CONTRACT DEPARTMENT.

It is doubtful if there is a more vitally important department in the conduct of a successful telephone exchange then the contract department. The business of the company originates there and its affairs should be in charge of a thoroughly competent contract agent, who knows how to secure business for the company on the best possible basis. This contract agent should be responsible for the character of the contracts taken under the rates adopted for the different classes of service to be furnished; as well as for the moving of telephones, changing of equipment, discontinuance of service, etc.; and all orders issued should be carefully made out, so that no unnecessary work may be shouldered upon the construction or equipment department.

RECORD DEPARTMENT.

The record department should be in such a condition that it will immediately be possible to refer to any and all records of construction, maintenance, equipment, operation, etc.

OPERATING DEPARTMENT.

The operating department should be actually and not theoretically in charge of the chief operator. There should be, of course, proper rules for all the employés of this company covering the duties assigned them. The duties of the chief operator may be outlined about as follows:

To see that all employés are prompt and regular in attendance; to have order and quiet at the time the forces are changed; to preserve neatness in the halls and rooms of the building through which the operators pass; and, above all, to keep the operating room free from confusion.

The chief operator should keep in intimate touch with the work of every operator by personal supervision, from

monitors and supervisors' reports; and should absolutely insist that each operator furnish speed, accuracy and courtesy in this work. Meetings should be held at least once a month, for the purpose of explaining the necessity of the rules made from time to time, and also for the purpose of arousing in each employé an active and enthusiastic interest in her work. The students can be carefully selected and coached. They should be made thoroughly conversant with all of the rules and impressed with the necessity of observing each rule; and thoroughly schooled in the proper care and use of the apparatus before being assigned to duty.

The chief operator should impress upon the operators the importance of prompt answering, prompt disconnect signals, supervision, proper testing and ringing. She should make tests on all parts of the service every day, keeping a record of complaints against operators and advancing them according to their merit.[1]

She should also preserve records, enabling her to give accurate information regarding the telephone number, name, address, date of in and out of all exchange lines, and see that new numbers are assigned so as to properly distribute the load of work on the different positions. Business and residence telephones should be properly distributed, so as not to overload any individual position.

Traffic record should be kept on all positions one day each month, in order to know the actual amount of work done by each operator and the average number of calls from each subscriber. All these reports should be sent to the manager at the end of the month.

SWITCHBOARD DEPARTMENT.

The switchboard department should be in charge of a thoroughly practical and capable switchboard man, who assumes all responsibility of the proper maintenance of the switchboard, power plant, and all auxiliary apparatus in the exchange. Everything should be kept neat and clean and the maintenance should be kept in such a manner that there will be very little depreciation, other than the cords on the switchboard.

WIRE CHIEF'S DEPARTMENT.

Under the direct supervision of the wire chief, should be furnished an assistant and trouble clerk. He should be responsible for the supervising and testing of all circuits entering the exchange; oversee all terminals and cables entering said exchange; keep a record of all cable repairs and the O. K. of all orders going through his department, making the necessary daily reports of the amount of trouble and the kind to the manager. He should be thoroughly competent and capable of guarding against errors and giving of wrong information to the maintenance department, where the trouble is taken care of.

MAINTENANCE AND EQUIPMENT.

This department is under the direct supervision of the superintendent of equipment, whose duty it is to see that all orders from the manager (or record department), covering installation, removal of equipment, etc., are properly executed and that proper specifications are made covering their work; also the maintenance of all apparatus; all interior wiring, and exterior wiring not included in the work handled by the construction department.

He should oversee the proper distribution of supplies and material which is taken from the stockroom by the men in his department.

The maintenance and equipment departments should be divided into four subdivisions under separate heads, namely: chief inspector's department, private exchange, equipment and maintenance, shop and repairs, material and supplies.

The chief inspector should have direct charge of the cable testing and the location of all cable trouble, all trouble-men, installers and inspectors and a clerk who keeps the records of this work and the orders issued.

The duties of the superintendent of equipment are to see that all orders to his departments are promptly and properly executed, and to aid the employés in his department in improving their methods, etc.

The private branch exchange department and employés should be under the direction of the foreman who has direct charge of the installation and maintenance of private branch exchanges and special interior wiring of buildings. He should be provided with the necessary help to assist in this work.

CONSTRUCTION DEPARTMENT.

This department is under the direction of a general foreman, whose duty it is to see that the work under his supervision is performed in compliance with specifications. His work should cover all the outside construction of conduits, cables (aerial and underground), pole lines and all other outside property of the company. He is under the direct charge of the manager, to whom he makes report of all work done, and his reports should show the time, labor, material on construction and maintenance; all employés hired or discharged by him, subject to approval. He should be provided with a requisite number of men to properly perform this work; and be thorough and competent to decide as to the difference in construction and maintenance.

He should personally know every new line that is constructed; see that same is properly installed; and keep up the maintenance of pole lines, cables, etc., to a condition of betterment.

SHOP.

The shop should be under the supervision of a foreman and the necessary employés provided to make all shop repairs and tests of apparatus turned over to him by the different departments, including the mounting and building of new apparatus.

DEPARTMENT OF MATERIAL AND SUPPLIES.

This department should be in charge of a stockkeeper, under the supervision of the superintendent of equipment, in so far as the overseeing that the proper amounts of material and supplies are kept on hand and given out according to the orders issued. The stock and material should be well looked after and taken care of, and accessible only to the stockkeeper.

It might seem that I have suggested an embarrassment of system and details in this brief outline; but it will be found that the more firm and rigid the system, the greater the ease with which the business of the exchange will conduct itself. It is only the manager who departs from the idea of discipline, who brings upon himself trouble with his employés and dissatisfaction on the part of the subscribers. Every good thing in this world has to be worked for—and the perfect telephone exchange is no exception to this rule. Certain efforts will produce certain results, and as a matter of fact there is no more labor involved in the conduct of the successful exchange and indeed not as much as in the management of one which is not successful.

[1] If it were possible and practical a daily record should be made showing the exact work done by each operator; that is, the number of calls answered, the average time both for service and disconnections. The present system of taking this record or peg count is necessarily laborious owing to the fact that it adds too much unnecessary work upon the operator for the good of the service.

Reviews of Current Engineering and Scientific Literature.

The Form of Voltage Curves before and after Transformation.

M. Charles David had occasion, during an investigation carried out recently, to make use of transformers for reducing high electrical purposes to values suitable for measurement in his instruments. The question was then raised, whether this transformation had any effect upon the form of the curve, and a supplemental experiment was made to decide it. Several transformers were used, which had the following characteristics: the weight of the iron was 42.5 kilogrammes. The induction in the yokes was 12,000 gausses. The induction in the cores was 9,000 gausses. The thickness of the sheets was 0.35 millimetre. The loss, unloaded, was eighty-one watts. The diameter of the high-tension winding was 0.2 millimetre, and that of the low-tension winding, 1.8 millimetres. The resistance of the high-tension circuit at twelve degrees centigrade was 1,200 ohms; that of the low-tension circuit at the same temperature was 0.57 ohm. The transformers were cooled in oil, and could carry a continuous load of from two to three kilovolt-amperes. They were but slightly loaded when supplying the apparatus. In order to detect any effect whatever due to transformation, an interrupter was introduced in the alternating current which gave irregular waves, and by means of an oscillograph these waves were traced, both for the primary and secondary windings. The transformation ratio was 5,500 to 110. Experiments were made with single, double and fourfold transformation. The curves for the different experiments are given. They are very irregular, but, in each case, the curves for the current before and after transformation are practically identical. There is no clear or systematic difference between them, which leads to the conclusion that there is no appreciable error due to the use of transformers for voltage measurements.—*Translated and abstracted from the Bulletin de la Société Internationale des Electriciens (Paris), March.*

Lightning Discharge Effects.

A peculiar result of a flash of lightning which struck a chimney of a house in Bournemouth, England, is described here by Mr. Edgar L. Ingram. The chimney was shattered, and the discharge passed to the wires of the electric lighting installation, which are connected to the local supply company's distributing mains. These mains are triple, concentric, lead-sheated cables, drawn into stoneware ducts. The cables are arranged as usual, with the outer conductor neutral, and with 400 volts between the inner and intermediate conductors, the supply to the consumers being at 200 volts. The neutral conductor is dead-earthed at the transformer chamber—780 yards away from the house struck—and the lead sheathing of the cables is dead-earthed in each draw box. The discharge appears to have found its way to earth through the neutral earth at the transformer chamber, in its course blowing all the distributing and main fuses of the installation, shattering the porcelain covers with such violence that one piece of poreclain broke a window some yards away, and blowing the cast-iron service fuse box to pieces. The meter connected on the pressure main was burned out, the metal cover twisted out of shape, and the filaments of a number of incandescent lamps broken. In one case, three small holes were pierced in the lamp globe, and the globe blackened all over the inside. In other cases, the filaments were broken into short lengths and protected against the glass with such force that many pieces adhered to the glass firmly. All installations within a radius of 430 yards had several lamps affected in this way, though in no case were all the lamps destroyed. Apparently, the triple concentric cable has not been hurt, nor have the shunt coils of the meters been injured. None of the lamps destroyed was switched on at the time of the accident.—*Abstracted from the Electrician (London), April 7.*

The Tuning of Thermoelectric Receivers for Electric Waves.

When experimenting with electric waves, two assumptions are frequently made. One is that the exciter and receiver are identical in wave length, since they are usually identical in form and dimensions. The second is that the wave length of the linear receiver is twice the length of the receiver itself. To test the accuracy of these assumptions, Mr. A. D. Cole has made an investigation, and here gives his conclusions. Two Righi exciters were used. In one, the radiating cylinders had an effective length of seventy-four millimetres, and in the other, fifty millimetres. Both were 3.1 millimetres in diameter. The separating oil-gap was a fraction of a millimetre long. The receiver was of the same form and diameter as the exciters, but its length was variable, and a thermo-junction of iron and constantin wire replaced the spark-gap. The length of the receiver was varied by sliding tubes of thin metal over its cylindrical ends, so that any length between thirty-nine and ninety millimetres could be obtained. To facilitate these adjustments of the receiver, it was mounted behind a cylindrical lens formed of a two and one-half litre bottle filled with benzine. This lens was quite effective in concentrating the radiations, as by means of it the deflections were increased about five times. The wave lengths were measured by three interference methods, which gave results in fairly good agreement—first, by reflection on a plane mirror behind the receiver; second, by reflection on a plane mirror behind the exciter; third, by Bolzmann's two-mirror method. By varying the distance of the mirrors, curves were obtained showing maximum and minimum galvanometer deflections. From these curves the following conclusions were drawn: when a thermal receiver of linear form is used in connection with a Righi exciter, interference curves show the wave length characteristic of the receiver. When the receiver length is changed until a distinct maximum effect is produced from a given exciter, it is probable that the fundamental wave length of each is the same; and the interference instrument will then—and only then—give the wave length of the exciter. The mean ratio of measured wave lengths to receiver length, as shown in five measurements, is 2.52, which agrees well with the value of 2.53, as determined theoretically by MacDonald, and not with the value of two, as given by Poincarè.—*Abstracted from the Physical Review (Lancaster), April.*

The Insulation Resistance of Impregnated, Paper-Covered, High-Potential Cables.

Frequently specifications for high-potential cables call for very high insulation resistance. The purchaser, says Herr P. Humann, seems to assume that, because it is not difficult to obtain a lower voltage cable with a guaranteed insulation resistance of 100 megohms per kilometre, a high-potential cable should have a resistance of at least 1,000 megohms. It is easy for the cable manufacturer to obtain a high resistance by saturating the paper

with a solid material, but this treatment renders the insulation stiff and brittle. On the other hand, if but one layer of paper of the many covering the conductor be cracked, the entire thickness of the insulation will be punctured as soon as a very high potential occurs. This phenomenon is easily demonstrated on a plate of any insulating material, such, for instance, as a plate of glass. Such a plate may be inserted between the sharp-pointed discharging electrodes of a high-voltage transformer, and, usually, the discharge will take place around the edge of the plate without breaking it. However, as soon as a slight scratch be made on the surface of the plate, it is punctured at this point. To avoid this objection to the use of solid compounds, oil may be used. This leaves the insulation flexible, but it reduces very considerably the insulation resistance. This reduction in insulation resistance does not necessarily mean an increased insulation loss, because this loss is made up of two factors, one due to the dielectric hysteresis, and the other to leakage. Herr Humann has compared two cables, to determine how great a difference might be expected. One had a resistance of 1,280 megohms per kilometre and a capacity of 0.284 microfarad for the same length. The second had a resistance of 10,850 megohms and a capacity of 0.282 microfarad per kilometre. The insulation losses for different voltages up to 8,000 were determined, and while those of the low-potential cable were about ten per cent greater, an error of this amount might readily be accounted for by the method employed. The conclusion is drawn, that the increased insulation resistance of the second cable does not appreciably reduce the insulation losses. A comparison was then made between two cables, one of which had not been thoroughly dried. In this case, the undried cable showed a much greater insulation loss than did the other. Herr Humann concludes that, in no case, should an insulation resistance of more than 1,000 megohms per kilometre at fifteen degrees centigrade be demanded. In general, a resistance of 500 megohms per kilometre will be as good as one of 1,500.—*Translated and abstracted from the Elektrotechnische Zeitschrift (Berlin), March* 30.

Bimetallic Rheostats.

The choice of the proper material for a rheostat is one of the important factors in its construction. For starting rheostats, where ventilation is of little importance, the problem is to store up a certain amount of heat in the cheapest way. The materials generally used for rheostats have high specific resistance, and are expensive. The method of construction suggested by Mr. H. M. Hobart, which makes use of cheap materials, but in which special provision is made for storing heat, is here described by Mr. F. Funga. The material used for the conducting wire is copper, and storage for heat is provided by adding iron wire in sufficient quantity; hence the term "bimetallic." Light copper wires are used for the conductors, and in the smaller forms of rheostats these are wound two or more in parallel, with a steep pitch, on porcelain tubes. The current density allowable is 150,000 amperes per square inch. Over the copper wire, or interwoven with it, but at a lesser pitch, are iron wires which make contact at many points. As the length of iron wire used is much greater than that of copper, the iron adds but little to the conductivity of the element. It has been found convenient to use the same diameter of iron wire for all sizes of rheostats. The iron wire is wound about six turns per centimetre of length, the copper wire having only one-half turn per centimetre of length. The greater the current which will pass through the element, the steeper the pitch of the copper wire. The tube form of rheostats is convenient for currents up to 100 or 150 amperes. For higher currents, the type adopted consists of two thick copper bars connected across by a number of parallel thin copper strips. Iron wires are intermeshed with these strips, and in this position add nothing to the conductivity, but greatly increase the heat storage capacity of the element. A simple method of winding the tubes consists in winding on one iron wire at a low pitch. The copper wires are then wound at an increased pitch, and over them is wound a second iron wire which falls in between the turns of the first. In this construction it is not necessary to tap on at intermediate points of the tubes. They may even be longer than is customary in the old type of rheostat, without necessitating any intermediate taps.—*Abstracted from Electrical Review (London), March* 31.

The 36,000-Volt Hydroelectric Installation of the Celina, Italy.

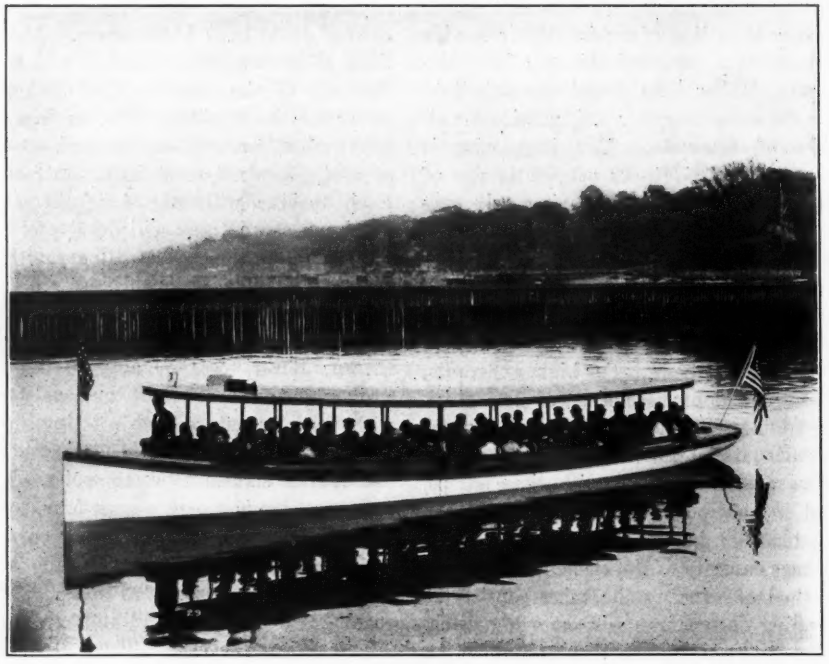
One of the modern hydroelectric installations of northern Italy is here described by Signor Enrico Bignami. The Celina river starts from the Claut at an altitude of 7,200 metres, in the Carnic Alps, and has a length of 453 kilometres. On account of its special geological conditions, it can deliver, at low water, about 30,000 litres per second. The new installation has been erected to supply electrical energy in the district of Venice. The construction was exceedingly difficult, for there was not even a pathway up the side of the mountain to the point where the dam has been erected. It is said that this work has cost more money and labor and lives of workmen than any other in Italy. The dam raises the water level at the intake three and one-half metres above the normal level, and creates a reservoir of about 300,000 cubic metres, to be drawn upon during periods of low water. The canal carrying the water to the power-house was also troublesome to build, and several tunnels had to be pierced for it. The power-house is close to the village of Malnisio. At this point the head of water is 58.64 metres. With a discharge of twenty cubic metres per second, there is available 15,600 horse-power. At the times of greatest consumption, and with the help of the reservoir, 18,900 horse-power may be obtained. The turbines are inward-flow reaction wheels, and consist of a single wheel on a horizontal shaft Each turbine will take 4,500 litres of water per second, and will develop at the shaft 2,600 horse-power at 315 revolutions per minute. The large turbines are connected direct, by means of rigid couplings, to three-phase alternators supplied by Brown, Boveri & Company, of Baden, Switzerland. These are of the usual type, with fixed armature and rotating field. The magnet wheel is a solid piece of steel, and carries sixteen alternate poles. The armature core is provided with four closed slots for each coil. The exciting current can be adjusted so as to vary the voltage at the terminals from 3,600 to 4,800. The commercial efficiency at full inductive load is ninety-five per cent. The fall of potential between no load and full load, with the usual speed and exciting current, is, with non-inductive load, five per cent of the normal voltage, and with inductive load, sixteen per cent. Direct current for exciting the fields of the alternators is provided by dynamos driven by three small turbines. Three single-phase transformers are used to raise the voltage to 30,000. When the primary voltage is raised to 4,300, the secondary voltage will be 36,000. All the switches work in oil. Those for medium voltage are double-break switches, and those for high-voltage, sextuple-break, enclosed in three separate boxes full of oil. The bus-bars are arranged in a ring which may be divided into two parts. All the electrical apparatus is controlled from operating switchboards.—*Abstracted from the Electrical Review (London), April* 7.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Electric Launch.

For the past six years the Electric Launch Company has maintained finely equipped modern boat-building shops on Newark bay, Bayonne, N. J. The company builds all kinds of pleasure craft, from launches to yachts. These are built on short notice, if necessary, from standard plans, or from the specifications of any yacht designer. The company makes a specialty of electric launches, and in this direction has been remarkably successful in placing in commission a long line of



ELECTRIC LAUNCH BUILT BY THE ELECTRIC LAUNCH COMPANY.

very satisfactory boats. The electric launch, by reason of the inherent simplicity of its motive parts, is the safest boat afloat. No inflammable fluid is carried, explosions are impossible, air tanks can be placed beneath the floor, and sinking is therefore out of the question. The electric launch is handled with great simplicity. There is no steam gauge to watch, no boiler in which to keep up steam. The only observation necessary is a glance now and then at the voltmeter, to determine the pressure of the storage batteries.

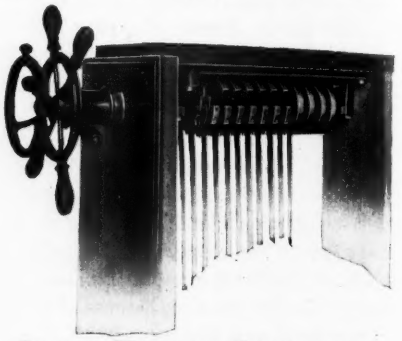
The electric launch is cheap in maintenance, using energy only as required. When the current is shut off, the operating expenses cease.

The objection which, for a long time, was leveled against the electric launch—that of the difficulty of maintaining the batteries properly charged—has been eliminated by reason of the many forms of convenient and portable charging outfits which have been recently placed on the market.

The company has done much to solve satisfactorily the battery problem. A lightweight cell of great capacity and durability is furnished. Three types of battery equipment are made. These will drive a twenty-five-foot boat for thirty miles, forty miles and fifty-five miles, respectively. In any of these types the plates need be renewed at intervals of about three years. The annual bill for repairs, including renewal, the company states, will be hardly more than five per cent.

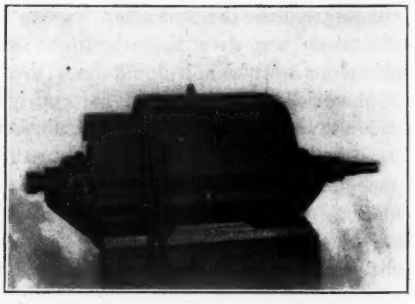
The boat hulls are built only of well-seasoned lumber, of long lengths, with white oak keel. The stem and deadwood are of oak or hackmatack, secured by galvanized iron rods, well riveted. The frames are of selected white oak, steam bent over moulds reenforced by oak floors and knees. The planking is of selected white southern cedar. The upper works and interior are finished in hardwood, oak being used for the sheer-strake mouldings and plank-sheer. The decks are finished in pine, oak or mahogany.

The speed controller is placed under the forward deck, giving five available speeds ahead and two reverse speeds. The steering and controller wheels are combined on one shaft located at the forward end of the cock-pit. The motor is directly connected with a Tobin bronze propeller shaft placed below the flooring. All bear-



STEERING WHEEL AND CONTROLLER FOR ELECTRIC LAUNCH.

ings of the motor are self-lubricating. The propeller wheels are of composition brass. The combination motor and charging switch, with charging plug, running plug and safety clip fuses, are fitted on the bulkhead. The batteries are placed under the floor below the water line, and supported on patent porcelain insulators. The elements of the battery are placed in patent marine-type hard-rubber jars, so constructed that the terminals may be securely clamped under or above the box covers by metal bindings. The spilling of the battery solution is impossible. The voltmeter and ammeter are placed conveni-



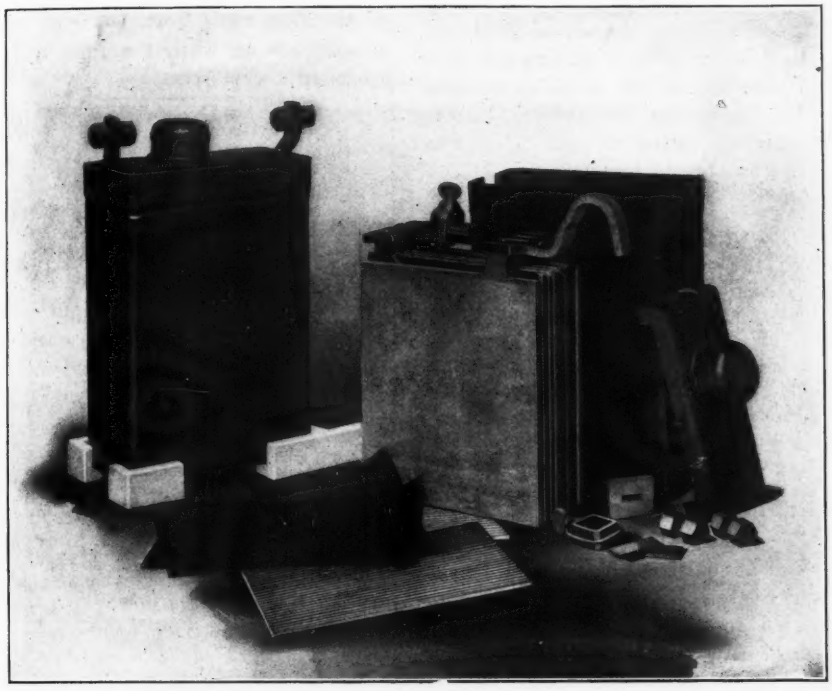
MOTOR FOR ELECTRIC LAUNCH.

ently on the forward bulkhead, near the controller and steering wheels. Only the best of insulated wire is used to connect the batteries with the motor. All wires are supported on porcelain insulators.

The company builds cabin electric launches in five sizes—thirty-six feet, forty-two feet, forty-seven feet, fifty-four feet and sixty-three feet.

One of the most popular boats that the

company builds is the electric passenger launch. This is particularly well fitted for the carrying of passengers, the motive machinery being mounted beneath the flooring entirely out of the way. Side seats provide ample accommodation for passengers, and, for roominess, no type of self-propelled boat can approach the electric launch. The battery capacity is sufficient for a continuous run of six to seven hours at a normal rate of speed.



Storage Batteries for Electric Launch.

A Demonstration of Heating and Cooking by Electricity.

On April 11 the Philadelphia Electric Company, Philadelphia, Pa., arranged a meeting for its district managers and solicitors, to familiarize them with the use of electric cooking and heating apparatus, and so promote the sale of apparatus and current for this service. A lecture was given on electric cooking and heating by Mr. Max Loewenthal, secretary and electrical engineer of the Prometheus Electric Company, New York city. Mr. Loewenthal showed by experiments the historical development of the electric heating industry, and presented considerable valuable data relating to this subject.

During the course of the evening a complete meal was prepared by means of Prometheus electric cooking apparatus by Miss Helen Tovell, and after the lecture this meal was served to those who remained.

Orders for Allen-Bradley Controllers.

The Western Electric Company, of Chicago, recently placed with the American Electric Fuse Company an order for Allen-Bradley electric controllers to equip all the new cranes being installed at the Hawthorne plant of the Western Electric Company. This is one of the largest single orders for electric crane controllers ever placed in Chicago, and the American Electric Fuse Company states that the order was given after a six months' thorough and rigorous test of Allen-Bradley controllers in the Chicago factory of the Western Electric Company.

The Allen-Bradley controllers for the Hawthorne plant are all standard type machines, ranging from three and one-half horse-power to fifty horse-power in size, and are adapted for use with Niles-Bement-Pond cranes. A number of the controllers are arranged to be set in the rear of the controller cage, and to be operated by extension levers from the front.

Despite the unusual size of the order, the American Electric Fuse Company made a very prompt delivery of the Western Electric Company controllers, all machines having been shipped complete within fifteen days after the order was placed. The American Electric Fuse Company is now turning out over one hundred Allen-Bradley controllers a month, an increase of almost one hundred per cent in less than six months' time.

Besides the Western Electric Company order, the American Electric Fuse Company has recently received orders from the George S. Smith Steel Casting Company, of Milwaukee; Lackawanna Steel Company, of Buffalo; Bethlehem Steel Company, South Bethlehem, Pa.; American Bridge Company, Ambridge, Pa.; John A. Roebling's Sons Company, Trenton, N. J.; Otis Elevator Company, New York; American Locomotive Company, Paterson, N. J.; Trenton Iron Company, Trenton, N. J.; Gould Storage Battery Company, Depew, N. Y., and many others.

To Manufacture Field and Armature Coils.

The Magnet Wire Company, New York city, has established a department for the manufacture of field and armature coils for electric railway motors. This company is well known as the manufacturer of "Magnet" wire, and has found that there is a large market for complete coils, not only among the smaller roads which have small shop facilities, but also among the greater systems, whose coil-winding departments are sometimes inadequate for the demands upon them. The Magnet Wire Company has recently purchased the designs and plant of a large electrical manufacturing and repair company, securing excellent facilities for electrical repair work and the manufacture of field coils. The new plant has been consolidated with the already existing plant of the company, making an extensive equipment.

Mr. H. S. Williston, who is a technical graduate and a member of the American Institute of Electrical Engineers, will take charge of this new manufacturing department. Mr. Williston is especially well equipped for this class of work, having had considerable experience in the manufacture of railway motor armature and field coils, and having been, for five years, in charge of this manufacture with the General Electric Company.

The company is prepared to manufacture both field and armature coils for existing types of railway motors. The more common forms will be manufactured in advance, in accordance with the usual specifications, and quantities kept in stock for emergency orders. The company is prepared to build, however, coils upon order for any requirement.

Mr. Edwin W. Moore is president, succeeding Mr. Valentine; F. H. Cowles is secretary, and J. Nelson Shreve, treasurer of the company.

Westinghouse New York Changes.

Westinghouse interests will occupy all but a small part of the nineteenth and twentieth floors of the new Trinity Building at 111 Broadway, New York, after May 1. The executive offices of the Westinghouse Electric and Manufacturing Company, which have for nearly twenty years been in the Equitable Life Building at 120 Broadway, will be on the nineteenth floor of the new building, and the eastern sales offices of the Westinghouse Air Brake Company and the Westinghouse Traction Brake Company will occupy a large part of the twentieth floor. The law offices of Hunt, Hill and Betts, which have been for several years in the Equitable Life Building, will be on the twentieth floor of the new building, and the remaining part of the floor has been sublet to an engineering company.

The United States Electric Light Company, which was absorbed by the Westinghouse Electric Company shortly after the organization of the latter company, opened offices in the Equitable Life Building in 1878, and the old building has been more or less a Westinghouse headquarters in New York for the past generation, and the New York office of Mr. George Westinghouse. The new offices in the Trinity Building will be more commodious to provide for the growth of the working staff in the treasury and other departments.

The New York sales offices of the Westinghouse Electric Company will remain in the Hanover Bank Building at Pine and Nassau streets, without changes, and the New York office of the Westinghouse companies' publishing department, formerly at 10 Bridge street, will be connected with them. The export offices of the electric company will continue at the same address, under the management of Mr. Maurice Coster, recently appointed to succeed Mr. F. B. H. Paine, and the office of Mr. Charles S. Powell, the new general agent of the electric company, will be connected with the sales and export offices. Mr. Coster and Mr. Powell have arrived from Paris and from London to take up their new duties after long terms of successful Westinghouse service abroad.

Mr. Coster, who has acted as sales manager of the Société Anonyme Westinghouse since the spring of 1899, has had a broad experience in domestic and foreign markets. His Westinghouse connection began in 1888, in Pittsburg, and later he acted as manager of the Chicago office of the electric company. His work for the French Westinghouse Company, which manufactures nearly all forms of Westinghouse products—railway appliances, prime movers, and electrical apparatus—involved several branches of engineering, and he will act as export manager in New York for the Westinghouse Machine Company as well as for the electric company. He has for many years been a full member of both the Electrical Engineers and the Mechanical Engineers.

Mr. Powell returns to America after two years and a half as assistant manager of the British Westinghouse Electric and Manufacturing Company, in which his duties brought him into contact with all the important plans for the electrification of England's traction systems and railroad terminals. Prior to his departure for England in December, 1902, Mr. Powell had acted as manager of the Cleveland offices of the Westinghouse Electric and Manufacturing Company, with which he began work in 1893. His brother, Mr. Thomas Carr Powell, was recently appointed fifth vice-president of the Southern Railway.

Electric Plants for the Supplying of Electricity to London.

The Administrative County of London and District Electric Power Company, which is responsible to a committee of the British House of Lords, is planning to construct three electric plants for generating current to supply the whole of London and those suburbs controlled by the London County Council. Each plant is to consist of six turbo-generators, each of 10,000 kilowatts normal, and 20,000 kilowatts maximum capacity, making a maximum total of 360,000 kilowatts. Experts have been appointed to decide upon the practicability of units of this size. The electrical expert chosen for this important problem is Mr. C. F. L. Brown, of Brown, Boveri & Company, Baden, Switzerland. The Crocker-Wheeler Company, Ampere, N. J., is the American licensee of Brown, Boveri & Company, which acts as its consulting engineer on alternating-current propositions.

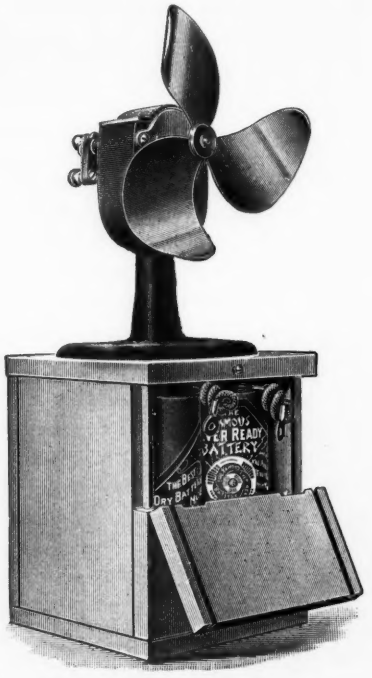
Publicity.

The Denver Gas and Electric Company, Denver, Col., is one of the most extensive users of publicity in the country. Hardly a day passes that every one in the city, and, in fact, outside of the city, who has any interest in, or need for, an electrical system does not receive some intimation from this enterprising company that electricity is the thing for overcoming every difficulty. The literature is presented in every conceivable form. A system of beautifully colored postal cards, delineating picturesque scenes throughout Colorado, is one form of publicity. A complete series of menus for various styles of dinners is another form. Then, again, comes a paper-folder in the shape of a key, bearing the inscription, "Here's the Key to the Situation." In fact, it is hard to see where all the ideas come from, and one begins to speculate on when the fund will be exhausted.

A New Battery Fan Motor Outfit.

The Electric Motor and Equipment Company, Newark, N. J., has placed on the market a portable electric fan, which is designated as the "Beaver" battery fan motor outfit. This is especially applicable for use in the sickroom, dining room, telephone booth, or, in fact, in any place where street current can not be obtained.

The fan motor consists of a carefully constructed small motor, a three-blade brass fan seven inches in diameter, and a switch provided on the back of the fan in an accessible position. Four high-grade dry batteries are contained in a neat, substantially made box, and connection is made to the fan motor by a flexible cord. The fan will run approximately fifteen to twenty hours continuously, or about 100 hours if used at infrequent intervals on one equipment of batteries. The weight, complete, is sixteen pounds, the weight of the fan motor being five pounds.

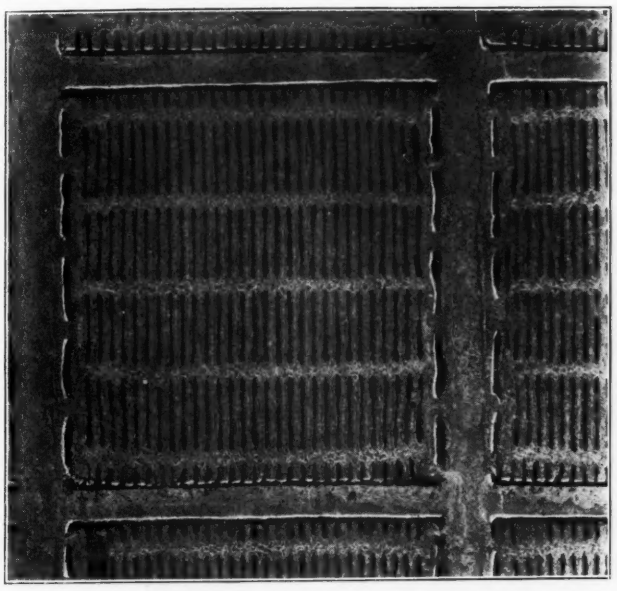


BATTERY FAN MOTOR OUTFIT.

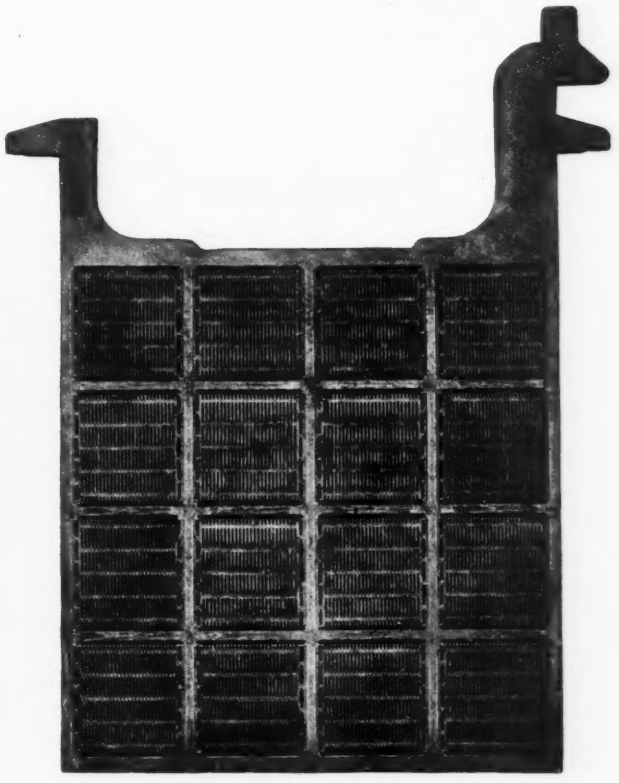
The Bijur High-Duty Storage Battery.

Some years ago Mr. Joseph Bijur, of New York, undertook to develop an improved type of storage battery. As a result of his labor, in which he had as collaborator Dr. J. S. C. Wells, of Columbia University, the cell to be described below has been produced. The aim of Mr. Bijur's endeavor was to devise a construction mechanically and chemically correct. The end to be attained was a rigid structure which should be free from any tendency to buckling, and which should, at the same time, allow free circulation of the acid and hold the active material so that it could not be displaced. To be successful, the cell should have a high specific capacity and admit of high rates of charge and discharge. Necessarily, the efficiency should be high, the regulation good, and there should be no tendency to sulphate. To construct a plate having these characteristics, it was decided that it must be made up of small parts, each free to expand, but all firmly welded together to a supporting and conducting grid.

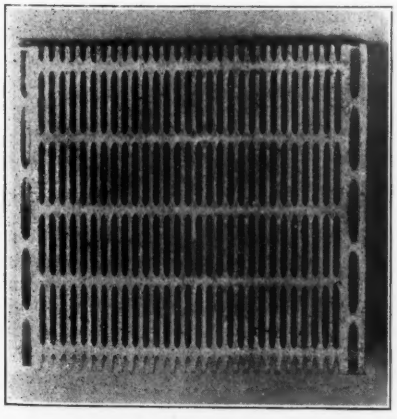
The type of plate finally decided upon is shown in the accompanying illustration. It will be seen that it consists of a number of small grills, which are supported at two opposite ends by being firmly welded to the supporting grid. These grills are cast in moulds under pressure, and are therefore one piece of lead; but they can be described best by comparing them with a number of flat ribbons of lead held together by short intermediate cross-pieces. The grills thus formed are held at intermediate points to the terminals which are welded to the supporting grid. This method of support allows the grill to expand in the direction of the support when formation takes place, and, as will be seen from the illustration, as the grill is attached to the grid at these sides only, the ends being free, expansion can take place freely in the other direction as well. The grills themselves are formed of pure



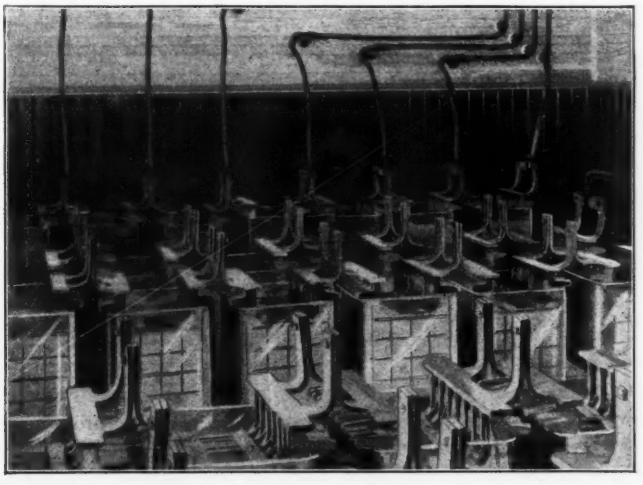
Section of Formed Plate, "Bijur" Battery.



Formed Plate, "Bijur" Battery.



Individual Grill.



Battery Equipment, Prospect Point Camp, Adirondack Mountains.

lead, while the supporting grid is an alloy containing a small percentage of antimony.

This particular form of plate has the following characteristics: formation takes place principally in the rectangular openings of the grill. As these openings are small, the depth of formation is slight, so that a large surface area is exposed to the electrolyte. After formation, it is found that these openings are not completely closed by the active material, so that the acid has free access to the interior of the plate. As the active material is formed, it wedges itself into the rectangular openings of the grill, tending to expand the latter into an elliptical form, and is thus wedged tightly in place and held firmly against the conducting lead of the grill. This formation, which exposes a large surface of thin active material, is held to give the following advantages: this large surface, always in contact with the electrolyte, permits of high rates of charge and discharge without injury to the plate, and, at the same time, there is but little polarization, so that the charging voltage is comparatively low.

Having decided upon a type of grid, the next step was to find a means of attaching the grills solidly to the grid. This has been done by devising a method of welding which, so far as can be determined, makes a perfect joint between the terminal of the grill and the sides of the grid. In the type of plate shown, the horizontal bars of the grid are cast first, and these, together with the requisite number of grills, are assembled in position, and then the vertical bars of the grid are cast, the welding action taking place when the casting is made. This welding is merely a union of the pure metal of the grill and the alloy of the grid. No solder or other material is used. The joint is so firm that if a grill be hammered it breaks to pieces, but the joint is not loosened.

The next step in the process is formation. The positive and negative plates are constructed in this way, but the negative, being somewhat thicker, has the increase in surface necessary to obtain a capacity equivalent to that of the positive plates. A new process of formation has been devised, which, the inventor believes, gives great toughness and porosity, and which is at all times under the control of the operator. After formation, the positive plates still have sufficient reserve lead to allow for the future oxidation which always takes place. The negative plates are, of course, fully formed in the first case.

The free diffusion obtained with this construction, it is said, allows the batteries to be charged fully with two and one-half volts only. This, of course, means a high efficiency and a decrease in the size of the auxiliary apparatus required.

The Bijur high-duty battery is now being placed upon the market by the General Storage Battery Company, which has equipped a factory at Boonton, N. J., with special automatic machinery for producing these batteries rapidly and cheaply. This point was selected because power could be obtained cheaply and abundantly hydraulically.

The company has also developed a new and complete line of automatic boosters, end-cell switches, and other auxiliary devices for all classes of station work and power plants. It is said that these devices differ as radically from the present types as does the Bijur high-duty plate from the usual storage battery plate.

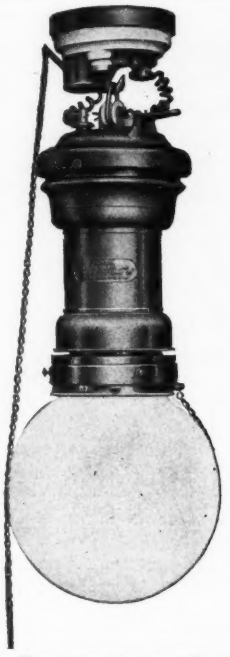
A recent installation of these batteries was made at Prospect Point Camp, on Upper Saranac Lake in the Adirondack mountains, when there was a small lighting plant driven by a 100-horse-power gasoline engine. The service for some reasons had not been satisfactory, so that a battery consisting of sixty-two Bijur cells was installed, the plates being eight by eight inches. Ten are end-cells for regulation. All are placed in a room sixteen feet long by thirteen feet wide. Since their installation, Prospect Point Camp has not been without light at any time of the day or night, and it is said that considerable economy in station operation has been effected, amounting to several times the interest and depreciation of the battery. The accompanying illustration is a view of this battery room. As operated at present, the engine is started at 5 P. M., and runs until midnight. During this period the battery is charged and current is furnished for such lights as are needed, the engine and dynamo running at full load. After midnight the engine is shut down, and during the rest of the twenty-four hours the load is carried by the battery, regulation being effected through the end-cells.

The General Storage Battery Company is now prepared to turn out cells of any size and for any purpose. It is fully equipped to furnish complete and durable installations.

The New York offices of the General Storage Battery Company are at 42 Broadway.

New Form of Ceiling Board.

The General Electric Company, Schenectady, N. Y., has placed upon the market an improved porcelain ceiling board for arc lamps. One of the most valuable features of this board is the use of a snap switch and a ratchet and chain, the lamp and board thus being self-contained and requiring no additional wiring to connect them with a switch. Every lamp in a circuit is made independent of the other lamps by means of standard Edison plug



NEW FORM OF CEILING BOARD.

cutouts, affording a better means of protection than a universal cutout. The ceiling board is furnished for either concealed or cleat wiring.

The hook from which the lamp hangs is supported by a spiral spring mounted in a recess in the porcelain. This spring takes up any jarring to which the lamp may be subjected, reducing vibration to a minimum. The ceiling board is particularly adapted for use with lamps installed on wharves, in railway stations, or in factories or mills.

The illustration herewith shows the new ceiling board supporting a form 5 alternating-current multiple arc lamp.

Electric Power for Spinning Mills.

An innovation in Lancashire, England, is attracting considerable interest among manufacturers of that section. A new spinning mill in Lancashire County, operating 84,000 spindles, is to be lighted and driven entirely by electricity. It is said that this will be the first establishment to be so operated. The supply of electricity is to be obtained from the mains of an electric power company. The experiment will have a double value, because it will test the feasibility of electric power in a great spinning factory, and test also the practicability of an outside source of power supply for such an installation.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

POWER PLANT ON THE SUSQUEHANNA RIVER—It is stated that New York capitalists have formed a company to build a power plant on the rapids of the Susquehanna river, in Pennsylvania. About $10,000,000 will be expended in the enterprise. The power is to be transmitted to Philadelphia for use there.

DEVELOPMENT OF WATER POWER IN TENNESSEE—A power plant is to be erected at Great Falls, on the Caney Fork river, to develop 50,000 horse-power, or more. Eastern capitalists have been investigating recently to ascertain the amount of electrical power which can be disposed of in the vicinity. It is stated that the property at Great Falls has recently passed into the possession of C. H. Ackerman, of Binghamton, N. Y.

NEW ELECTRIC LIGHT AND POWER COMPANY IN NEW JERSEY—The Paterson Electric Light, Heat and Power Company has been formed with a capital of $500,000. The stock is held principally in the city of Paterson, and it is the intention of the company to extend the business of furnishing light and power to all the cities in the vicinity. Peter S. Van Keik, Angelo H. Knapp, Thomas Jornold and others are the organizers.

ELECTRIC ROAD IN BARBADOES—A steam railroad on the island of Barbadoes, running from Bridgeton to the opposite coast, is to be operated by electricity. The tramways of Bridgeton, which are now operated by mules, have been purchased by an English company, which has also bought the electric light plant. It is proposed to change the traction power of the tramway system to electricity, and operate the cars over the steam railway which is at the present time abandoned.

WATER-POWER PLANT ON THE WATEREE RIVER, S. C.—It has been announced that a syndicate will construct a power plant on the Wateree river, seven miles from Camden, S. C. The syndicate has a capital of $2,000,000, and has purchased the site for the station at a cost of $100,000. The plant is to generate not less than 14,000 horse-power, and the surveys have already been completed. The legal representatives are Smyth, Lee & Frost, of Charleston. S. Logan Lang, William M. Shannon and F. M. Zemp, of Charleston, are said to be interested in the scheme.

ELECTRICAL NOTES FROM MEXICO—A waterfall at Amaxtlan, in the Las Lajas mountains, Guerrero, has been sold to an American company for $100,000. The purchasers will construct a hydroelectric plant. The tramway lines in the city of Mexico will increase their equipment by forty cars during the present year. The first order will be placed about May 1, and another about September 1. An electric plant is to be installed at San Miguel de Allende, Guanajuato. The power will be obtained from a fall near Atontonilco, about ten miles from San Miguel.

CONSOLIDATION OF ELECTRIC LIGHT AND POWER PLANTS IN LOUISIANA—The electric light and power plants and the street railway of Baton Rouge, La., are to be consolidated in one company. The enterprises are the Baton Rouge Electric and Gas Company, the Capital Light and Power Company and the street railway company, which is already controlled by the Baton Rouge Electric and Gas Company. The new concern will extend the street car service so as to afford traffic accommodations to all parts of the city, and will spend about $100,000 in improving the lighting system. The electric light plant will probably be rebuilt.

ELECTRIFICATION OF TRAMWAYS IN LONDON, ENGLAND—The highways committees of the London County Council has recommended the electrification of a line of tramways in southern London. The line comprises seventeen and one-half miles of single track, and extends from Westminster bridge to Vauxhall, and thence through Battersea to Nine Elms and Tooting, where it will join the existing line. Another line to be electrified extends from Vauxhall to St. George's Cross. The cost of the work will approximate £450,000, of which £280,000 is for track work, £51,000 for cables and cable ducts, £31,400 for cars, and £57,000 for car sheds and substations.

ELECTRIC FREIGHT ROAD IN NORTH CAROLINA—The Asheville & Burnsville Railroad Company has secured the rights of the Weaverville & Asheville Electric Power Company and also of the Estatoe Electric Company. The capital stock of the new company is $1,000,000, and the officers are George D. Mills, Warsaw, Ind., president; E. F. Watson, Burnsville, N. C., vice-president; W. W. Chapman, of Yancey County, N. C., secretary and treasurer. The company is to build a road from Boonford, in Mitchell County, to Asheville, N. C. The road will run through fifty miles of timber land and carry freight exclusively. About ten miles of the grading are completed. A dam has been built on the Estatoe river, forty-three miles from Asheville, and will furnish 1,000 horse-power. The company is to build another dam on the Kane river, to furnish an additional 750 horse-power. The line will cost about $1,250,000, and it is expected that the road will be in operation within one year.

NEW MANUFACTURING COMPANIES.

ST. LOUIS, MO.—The Doxsee-Barrere Electric Company has been organized with a capital of $30,000, by Arnold S. Doxsee, William H. Barrere and I. J. Doxsee.

ALTON, ILL.—M. S. Anderson has organized the Anderson Electrical Company. The company will buy and sell motors, and do general repair and construction work.

AKRON, N. Y.—The Talbot Electric Company has been formed at Washington by Emmet Talbot and Francis Whitney. The company will deal in electrical appliances.

KOKOMO, IND.—The Rex Electric and Supply Company has been organized with a capital of $1,000. Frank L. Clifford, Charles L. Moore and J. H. Richardson are the incorporators.

PORTLAND, ME.—The Postal Telephone Company has been organized to deal in telephone instruments, with a capital of $500,000. H. E. Mason, Portland, is president, and J. J. Hernan is treasurer.

COLUMBUS, OHIO—The Ross Electric Specialty Company, of Cleveland, has been incorporated with a capital of $10,000 by W. H. Kildow, M. Aldredge, George W. Ross, J. W. Burwell and H. C. Gahn.

NEW YORK, N. Y.—The Thomas & Betts Company has been organized to do a general electrical business. The capital is $50,000, and the incorporators are William Bailey, J. Foster Symes and Adnah McMurtrie, of New York city.

ALBANY, N. Y.—The Empire Engineering Company, of New York city, has been incorporated with a capital of $1,000,000, to do a general engineering and contracting business. The directors are Edward D. Adams, Lindon W. Bates, William Barclay Parsons, Alfred Skitt and William S. Hulse, of New York.

TROY, N. Y.—The Eastern Electric Company, of Troy, has been organized to do a general contracting business. The capital is $100,000, and the directors are W. Lewis Burke, W. C. Colburn, Henry J. Speck, James H. Caldwell, William Connors, Cornelius Collins, Troy; E. Frank Andrews, Saratoga Springs.

SACRAMENTO, CAL.—Articles of incorporation have been filed for the Electrical Appliance Development Company with a capital of $64,000. The directors are Herman H. Grau, William Ellery Briggs, J. C. Ellis, Charles W. Hutton and Frederick T. Kitt, all of Sacramento. The purpose of the company is to deal in mechanical devices.

ELECTRIC LIGHTING.

CONRAD, IOWA—W. J. Stanton is projecting an electric light plant for Conrad.

COLUMBIA, PA.—The Columbia Electric Light and Power Company has been granted a franchise.

LINDSAY, NEB.—It is stated that plans are being made for the installation of an electric light plant in Lindsay.

ALBION, N. Y.—The board of trustees has granted a franchise to the Niagara Falls Power Company to furnish power to Albion.

SODUS, CAL.—Work is now being hastened on the building for the Sodus Gas and Electric Light Company. It is planned to have the plant in operation by June.

ST. JOHNSBURY, VT.—The village trustees have signed a contract with the St. Johnsbury Electric Company to furnish street lights for the year 1905 at the old price, $64.30 per light.

SILVERTON, COL.—Owing to the inadequacy of the Silverton municipal electric plant to supply the demand for light and power the council has decided to install an additional engine.

McKINNEY, TEX.—The contract for the municipal electric light plant has been let to J. Payton Hunter, of the Hunter Electric Light Supply Company, of Dallas, for $6,500, which covers the necessary material and machinery.

CATSKILL, N. Y.—At the annual election of the Catskill Illuminating and Power Company the following were reelected: W. S. C. Wiley, president; A. M. Young, vice-president; A. O. Shepardson, secretary; W. E. Lampman, treasurer.

MEXICO, MEXICO—A stock company, with a capital of $30,000, to build an electric light plant at Nuevo Laredo, the terminus of the National Railway, on the Mexican side of the Rio Grande, is being organized by Octaviano Gonzalez and associates.

TROY, N. Y.—Because of the extensive interests of the Hudson River Water Power Company and its subsidiary companies in the central part of the state, the principal business offices of the companies will be removed from Glens Falls to Albany.

YORK, PA.—Four electric light companies of York County, the Dallastown, the Red Lion, the Yoe and the Windsor, have been merged into one company under the corporate title of the York & Windsor Electric Light Company. The merged company will have a capitalization of $30,000.

DENVER, COL.—The Guanajuato Power and Electric Company held its annual election of officers in Denver recently, with the following results: Henry Hine, John Hays Hammond, Leonard E. Curtis, Irving W. Bonbright, Horace G. Lunt, John S. Bartlett and C. A. Coffin, reelected directors.

HARTFORD CITY, IND.—Montpelier has found that municipal ownership is a failure, and the city council of that place has passed a resolution turning the control of the light and water plant over to R. G. Kerlin. For a number of years the town of Montpelier has been operating its own water and light plant at a loss.

COLUMBIA, S. C.—It is announced that the Mercantile Trust and Deposit Company, of Baltimore, has purchased the Columbia Electric Light and Power Company. It is also stated that this new affiliation of the Columbia company will not affect its local connections, the executive management remaining the same.

CARLISLE, KY.—A new stock company, with C. C. Cole as president; M. V. Bostain, vice-president; George A. Straus, secretary; John N. Riss, treasurer, has been organized for the erection of a new and modern up-to-date electric light plant, to cost not less than $15,000. Work has begun and light is promised in sixty days.

CHICAGO, ILL.—The Chicago Edison Company will build three substations. At 77 and 79 Plymouth place it will build a three-story station, sixty-two by fifty feet, at a cost of $60,000; at Twenty-second street and Wabash avenue, a substation, fifty-three by sixty-four feet, to cost $50,000, and at Twenty-second and Fiske streets another.

WALLA WALLA, WASH.—The announcement is made that Isaac Anderson and associates, acting for the Northwestern Gas and Electric Company, will build forty miles of transmission line from Pendleton to below Echo and to the Columbia river to furnish power to pump water from the river to irrigate a large tract of desert land.

DENISON, TEX.—The annual meeting of the directors of the Denison Light and Power Company was held recently. Those present were John P. Scullin, of St. Louis; J. T. and W. B. Munson and J. B. McDougall. W. B. Munson was elected president of the company; J. B. McDougall, vice-president, and W. A. Everitt, secretary and manager.

CENTRAL CITY, KY.—The city clerk of Central City recently sold at public auction to the highest bidder the franchises for electric light and street railway. B. F. Creech was the purchaser of both franchises. The conditions under which the sale was made are that the electric light plant shall be completed in eight months and the street railway in eighteen months.

CONNERSVILLE, IND.—A few weeks ago the Connersville Gas, Electric and Power Company was sold at receiver's sale to George B. Markle, of Hazleton, Pa. The new ownership will incorporate as follows: George B. Markle, president and treasurer; R. Neil Burgess, of New York, vice-president and secretary. Mr. Markle, Mr. Burgess and Mrs. Burgess will be the directors.

INDIANAPOLIS, IND.—The new contract between the city and the Indianapolis Heat and Light Company has gone in effect, and will be effective for a period of ten years. This contract provides for the establishment of electric lighting service in any part of the city, upon the petition of property owners, and fixes the yearly rate of the arc street lights at seventy-four dollars per year for each light.

BUTTE, MONT.—The transfer of the Gallatin Light, Railway and Power Company to the Butte Electric Power Company has been completed. The property bought by the Butte company comprises the electric light and street railway systems of the Gallatin County capital, in which the controlling interest was held by Samuel Mendenhall and the estate of Henry Elling. Power for operating the two systems will be obtained from Madison County.

SAN FRANCISCO, CAL.—Charles R. Muller and F. A. Keith have closed a $250,000 contract for the construction of an electric power transmission plant to be located in California, just across the line from Nevada, at a place called The Wells, where there is a plentiful supply of water. Messrs. Miller and Keith are members of an eastern syndicate which has arranged to furnish electric light and power to the Tonopah mine owners and the inhabitants of the Tonopah and Goldfields districts.

LAWRENCEBURG, KY.—The differences between the Lawrenceburg city council and the Electric Light Company have been obviated, and a formal contract has been signed and delivered. The company will begin work on an independent plant as soon as estimates can be prepared and contracts let, and it expects to have the plant in operation within the next four months. The city has an option to purchase the plant at any time within twelve years. The cost will be in the neighborhood of $12,000.

HATTIESBURG, MISS.—The Hattiesburg Light and Power Company has issued a schedule of rates for lighting. The flat rates for lights up to twelve o'clock, midnight, range from a minimum charge of $1 per month up to $6.10 per month, for ten sixteen-candle-power or twenty-eight-candle-power lights. For lights burned all night there is a flat rate of $1 per month for each sixteen-candle-power lamp. The rate for motors ranges from $1 per month for a one-eighth-horse-power motor, to $20 for a five-horse-power motor. For each additional horse-power above five, the charge is $4 per month.

MUSKEGON, MICH.—The Muskegon city council has granted a twenty-five-year franchise to the M. B. Wheeler Electric Company, of Grand Rapids, to furnish electricity for light, heat and power. According to the provisions of the franchise all wires of the company must be laid in conduits in Western avenue, from Pine to Seventh street, and in the valley parallel with and lying between Western and Clay avenues, between Pine and Fourth streets. The company is to pay a fee of $100 a year. The franchise must be accepted in ninety days and the work of installing the wires and apparatus must be completed in four years, or the franchise shall be forfeited.

TELEPHONE AND TELEGRAPH.

IMOGENE, IOWA—A rural telephone system is being built between Imogene and Colfax.

COLUMBUS JUNCTION, IOWA—Charles Estle has been granted a franchise for a telephone exchange at Columbus Junction.

CLINTON, IOWA—The Iowa Telephone Company plans the expenditure of about $100,000 in placing its wires underground.

HOBOKEN, N. J.—A new office building will shortly be erected by the New York & New Jersey Telephone Company in Hoboken.

NEW ORLEANS, LA.—The Cumberland Telephone and Telegraph Company will install an up-to-date telephone exchange at Algiers.

COUNCIL BLUFFS, IOWA—Work will begin at once on the Council Bluffs exchange of the new Independent Telephone Company.

FORT WORTH, TEX.—The Southwestern Telephone and Telegraph Company has purchased a plot of ground in Fort Worth, upon which it will erect a new exchange building.

SAN DIEGO, CAL.—The Home Telephone Company will shortly commence work on a number of extensions to its system. These include lines to National City, La Jolla, El Cajon, Ramona, Lakeside, Julian, Alpine and other near-by towns.

EAST PEMBROKE, N. Y.—The directors of the East Pembroke Telephone Company have elected officers for the ensuing year as follows: president, E. C. Richardson; vice-president, Wilber C. Choate; secretary, C. C. Day; treasurer, Ezra A. Seamans.

MINNEAPOLIS, MINN.—The Twin City Telephone Company will erect a $30,000 toll station in Merriam Park during the coming summer. The statement is also made that the company will construct over 1,000 additional miles of long-distance lines during the year.

BLOSERVILLE, PA.—Citizens of Bloserville and vicinity have organized a telephone company, which will be known as the Bloserville Telephone Company. The company will begin the construction of a line from Bloserville to Newville to connect with the United Telephone and Telegraph lines.

DECATUR, ILL.—The Morgan County Telephone Company has about 150 men at work building a long-distance telephone line from Decatur to Birmingham, a distance of eighty-seven miles. At Birmingham connection will be made with all the cities south, and at Memphis with cities west, south and east.

TRAER, IOWA—The farmers of north Tama County, not satisfied with the service they are receiving, are considering the matter of installing an exchange of their own. The plan is to charge a $6 membership fee for country patrons, and $12 for city patrons, and to tax each telephone $3 a year to maintain the exchange.

ROCK HILL, S. C.—The Rock Hill city council has granted a ten-year franchise to the Rock Hill Telephone Company. The city has the privilege of using the company's poles for fire-alarm, police, telegraph and telephone wires. The rate for instruments is not to exceed two dollars per month for residences, and three dollars for business houses.

CORNING, N. Y.—The Corning Telephone Company announces the completion of a new line connecting Monterey and Beaver Dams and intermediate points. The Bell company's exchange now makes direct toll-line connections to Buena Vista, South Howard, Jonesville, North Cameron, Cameron, Cameron Mills, North Jasper, Swale, Adrian and Bonny Hill.

LOS ANGELES, CAL.—At a meeting of the stockholders of the Home Telephone Company officers for the ensuing year were elected as follows: president, Charles E. Summer; vice-president, Heber Ingle; secretary and treasurer, William Godfrey. Directors, William Mead, of Los Angeles, and Heber Ingle, L. J. Wilde, Roscoe Howard, Charles E. Summer and William Godfrey.

BERKELEY, CAL.—The Pacific States Telephone and Telegraph Company is planning a number of improvements to its system in Berkeley. Many of the wires will be placed underground, and a number of new aerial circuits installed. The company is replacing ten-party lines with four-party, two-party and main lines, and will also enlarge its central switchboard to accommodate the increased number of subscribers.

PENN YAN, N. Y.—The annual meeting of the Dundee & Crystal Springs Telephone Company was held at Crystal Springs recently, and the following directors elected for the ensuing year: Frank VanGordon, Barrington; Alfred Horton, Delmar J. Knapp, Barrington; Lyman Pitcher, Lyman Disbrow, George O'Neil, Herbert Lazenby, Tyrone. The following officers were elected: president, Delmar J. Knapp; vice-president, Frank VanGordon; secretary and treasurer, Lyman Disbrow.

WEST PALM BEACH, FLA.—A franchise has been asked for by Dr. J. T. Liddy and associates to build a telephone system. The ordinance submitted provides for commencing the work of installing the system within six months after its passage. Within twelve months the building must be completed. The schedule is not to exceed eighteen dollars per year for private houses and twenty-four dollars per year for hotels and business houses per instrument. The franchise is asked for a term of thirty years.

DENVER, COL.—Extensions of the Colorado Telephone and Telegraph Company, which will cost $200,000 to $250,000, and which will connect Denver with Santa Fe and Albuquerque, N. M., by telephone has been decided upon. At present the local telephone company has been operating in New Mexico only as far as Las Vegas. It is expected that the whole of the extension will be completed by early fall, although many New Mexican places now without telephones will be connected with Denver long before that.

BEAUMONT, TEX.—The new plant of the Southwestern Telephone and Telegraph Company in Beaumont is rapidly nearing completion. A new and modern switchboard will shortly be installed in the exchange headquarters in the Landry Building on Pearl street. When the new equipment is installed approximately fifteen miles of cable will have been strung and the switchboard installed with a capacity of 1,500 telephones, which can be increased to 5,000 if necessary. It is estimated that the equipment installed by the company will be sufficient for the needs of Beaumont for many years.

SPARTA, TENN.—The Gainesboro Telephone Company held its ninth annual meeting of stockholders at Gainesboro recently. The report of the manager showed such a prosperous condition that the dividend was increased from six to seven per cent, beginning July 1. The former directors and officers were reelected. It was decided to spend $50,000 in construction work in Tennessee and Kentucky during the coming summer, new stock to be issued as needed. This company, the headquarters of which are at Sparta, has 2,200 miles of toll line, and operates twenty-five exchanges in Tennessee and Kentucky.

BROKEN BOW, NEB.—A cooperative telephone company has been organized at Broken Bow, for the purpose of purchasing the plant of the Central Telephone Company. At a recent meeting the following directors were elected: J. D. Ream, Broken Bow; M. S. Eddy, Merna; W. E. Warren, Anselmo; William Warren, Calloway; Charles Jeffords, Broken Bow; Thomas Arthur, Comstock; J. O. Taylor, Berwyn; J. E. Cavance, Georgetown, and F. E. Delano, Lee Park. J. D. Ream was elected president, M. S. Eddy, secretary, and L. H. Jewett, treasurer. The cooperative companies of Milburn and Anselmo will effect an agreement with the new company.

CONNELLSVILLE, PA.—The Somerset Telephone Company has put into operation two lines from Pittsburg to Baltimore. The new lines are Nos. 8 and 10. The No. 8 line extends from Meyersdale to Pittsburg, *via* Connellsville, and No. 10 to Pittsburg, *via* Somerset and Johnstown. This makes direct independent connection between Pittsburg and all the principal points in Ohio and West Virginia, *via* Tri-State lines. At Baltimore connection will be made with the Maryland Telephone Company, and communication will be established with York, Pa.; Frederick, Md.; Hagerstown, Md.; Martinsburg, W. Va.; Winchester, Va.; Wilmington, Del. At Philadelphia connection will be made with the Keystone company. The Pittsburg connection is with the Pittsburg & Allegheny Telephone Company.

ELECTRIC RAILWAYS.

VALLEY CITY, N. D.—A franchise for a street railway has been granted to O. A. Beeman.

BALTIMORE, MD.—The United Railways Company is to build a new power station with a capacity of 4,000 kilowatts.

MUNCIE, IND.—The Indianapolis & Martinsville Rapid Transit Company will build an extension from Martinsville to Bloomington this year.

CLINTON, S. C.—An electric road is projected to connect Clinton with Spartanburg and Laurens. J. F. Jacobs is at the head of the enterprise.

PITTSBURG, PA.—Work will soon be started on the Wilkinsburg, Turtle Creek & East Pittsburg street railway. The cost of the road will be about $200,000.

BURLINGTON, IOWA—The street car company has received from the city council the right to construct a number of extensions and to double track some of its lines.

SAYRE, PA.—A franchise has been granted to the Sayre & South Waverly Trolley Company. Work must begin within six months. The road is to be completed by December 1, 1907.

COLUMBUS, OHIO—The Columbus, Delaware & Marion Electric Railway is preparing to extend its lines from Marion to Galion. This will give a through service from Cincinnati and Columbus to Cleveland.

MONTGOMERY, ALA.—The Montgomery Traction Company has given a mortgage for $2,000,000 to the Real Estate and Trust Company, of Philadelphia. The money is to be used to build new lines of road and rebuild old lines.

LIMA, OHIO—The Lima Electric Railway and Light Company has been sold to a syndicate of Philadelphia capitalists, headed by Thomas Dolan and Randall Morgan. The new owners propose to extend the line from Lima to Toledo.

ELGIN, ILL.—M. Long, of Woodstock, and other capitalists are securing the right of way for an electric line north from Carpentersville, the terminus of the Elgin, Aurora & Southern Traction Company's road, to Fox and Geneva lakes.

LAGRANGE, IND.—The part of the St. Joseph Valley traction line between Lagrange and Shipshewana has been opened. The line will be extended to Middlebury at once. It is expected that the road will be pushed to Elkhart this summer.

BANGOR, ME.—The Bangor Railway and Electric Company has been organized with a capital of $1,000,000. The new corporation absorbs a number of other railways and electric companies in and around Bangor. John T. Graham is president.

BIG STONE GAP, VA.—Local capitalists have started a survey for 100 miles of electric road to radiate from Big Stone Gap to Appalachia, Stonega, Norton, Wise, Toms Creek and Dorchester. Mineral and timber property will be touched.

BLOOMSBURG, PA.—The Bloomsburg & Millville Electric Railroad has elected the following officers: president, C. W. Miller; directors, L. E. Waller, C. W. Miller, C. M. Creveling, J. C. Brown, Joseph Ratti, C. C. Peacock, Ellis Eves. Construction of the road is to begin immediately.

RICHMOND, IND.—The Tucker-Anthony Syndicate, of Boston, Mass., has announced that it will construct a traction system to connect Indianapolis and Terre Haute. The new line will parallel the St. Louis division of the Big Four Railroad, and pass through several important towns in Indiana.

SEATTLE, WASH.—A franchise has been granted for an electric railroad crossing the south end of Elliott bay and piercing Riverside and Mountain View precincts, in a southerly direction to the end of the McSorley road. The franchise was taken out in the names of Howard H. Lewis and John P. Jacobsen.

RALEIGH, N. C.—A charter has been issued to the Greensboro Railway and Light Company, authorizing the purchase, construction and operation of street railway and lighting plants. The company has $750,000 capital, and the principal stockholders are F. R. Williamson and W. W. Damwell, Greensboro.

CUMBERLAND, MD.—It is reported that a company has been formed to build an electric railway from Rowlesburg, W. Va., to Durbin, a distance of 100 miles. C. W. Mosser and C. E. Mower, Hendricks, W. Va.; E. D. Baker, Beverly, W. Va.; H. A. Armstrong, Parson, W. Va., and R. F. Whitner, Philadelphia, are incorporators.

HARTFORD, CT.—Boston capitalists have bought the Hartford, Manchester & Rockville trolley system and charter of the company, giving them the right to build from Rockville to Worcester, Mass. This line is to built, giving a trolley from Hartford to Boston twenty-three miles shorter than the steam road.

GREENFIELD, IND.—A company has been organized to build an electric railway from Fortville, in Hancock County, to Shelbyville, through Maxwell, Greenfield and Fountaintown. The promoters are M. B. Walker, of Fortville; J. M. McCreery, of Indianapolis; Arthur Jones, of Alexandria; Edwin Downey, of Anderson, and W. A. Hough, of Greenfield.

CUMBERLAND, MD.—The Cumberland & Westernport Electric Railway has been transferred to the Lonaconing & Westernport Electric Railway. The directors of the new Cumberland & Westernport Electric Railway are: Judge R. H. Kock, Pottsville, Pa.; U. B. McCandlish, Piedmont, W. Va.; Roderick Clarey, W. A. Morgart and De Warren H. Reynolds, Cumberland.

DENVER, COL.—The Arapahoe county commissioners have granted a franchise to the Colorado Monorail Company to build a road from Denver to Littleton. The company purposes constructing and operating a system having but one rail. It will use a double trolley. Work must be started before July 1, 1905, and cars must be running before January 1, 1906.

YORK, PA.—A syndicate of Philadelphia capitalists has been granted a charter by the state department to build a street railway from York to Long Level, on the Susquehanna river, a distance of fourteen miles, and taking in the towns of Green Hill, Longstown, Yorkanna and East Prospect. The directors are Joseph T. Walmsley, John F. B. Atson, William Fine Gleason and Joseph B. Lanning, all of Philadelphia.

CHICAGO, ILL.—The Chicago, Kankakee & Champaign Electric Railroad Company has been incorporated with a capital of $100,000 to build a road from Chicago to towns in Will, Kankakee, Iroquis and Champaign counties. The incorporators and the first directors are F. L. Butterfield, C. V. Donovan, W. J. Root and Attorney C. O. Patton, of Chicago; E. D. Risser, R. A. McCracken, of Paxton, Ill., and Upton Schaub, of Watseka.

LAFAYETTE, IND.—The Lafayette & Southwestern Traction Company proposes to build from Lafayette into the Indiana coal fields. The capital stock will be $1,000,000. It is understood that the right of way of the Fountain-Warren Traction Company will be used by the Lafayette & Southwestern and that the directors of the former road will be interested in the new venture. William S. Baugh, of Lafayette, is at the head of the road.

BOSTON, MASS.—A charter for a new trolley line between Boston and Haverhill has been obtained by incorporators interested in the Haverhill and Boxford and the Maplewood and Danvers companies. The Haverhill and Boxford line will be eleven miles long, and will have a capital of $110,000. The Maplewood company's line will be nineteen miles long and will be capitalized at $190,000. The route of the combined companies will be through Malden, Melrose, Saugus, Lynnfield, Peabody, Middleton, Boxford and Haverhill.

ST. LOUIS, MO.—The county board of Monroe County, Ill., has granted a franchise to the East St. Louis, Waterloo & Chester Suburban Railroad Company for an electric line from East St. Louis to Columbia, Waterloo, the Mammoth Cave, Red Bud and other points through to Chester. Construction work will begin within thirty days and the road be completed by November, 1906. The company has also been granted the right of way through Randolph County to Chester, and expects to secure a similar privilege through the western part of St. Clair County. Thomas N. Chase, of St. Louis, is president of the road.

PERSONAL MENTION.

MR. HORATIO A. JOHNSON, northwestern manager for the American Telephone and Telegraph Company, with headquarters at St. Paul, Minn., has resigned. He is to be succeeded by P. K. Harlan, of Chicago.

MR. JAMES F. BOYLE, manager of the Pittston, Pa., office of the People's Telephone Company, has been transferred to Scranton as manager of the material department, and will enter on his duties in that city May 1.

MR. EDWARD B. ELLICOTT, city electrician of Chicago, Ill., has been selected as principal assistant engineer of the drainage board. Mr. Ellicott probably will have charge of the water-power development works at Lockport.

MR. J. E. FORMAN has tendered his resignation in the electrical department of the Burlington railroad shops at Hannibal, Mo., to accept a position as constructing engineer for the electric street car line which is to be built at Monroe, La.

MR. WILBUR B. DRIVER announces that he has disposed of his interest in the Driver-Harris Wire Company, of Newark, N. J., and has resigned as president of that company. He will hereafter devote himself to the sale of special materials to meet particular requirements.

OBITUARY NOTICE.

MR. ARTHUR C. FROST, for many years superintendent of the Direct United States Cable Company, died on Sunday, April 23, at his home in New York city. He was fifty-one years of age, unmarried, and had no relatives in this country. He came from Wakefield, England, twenty years ago, and for thirty years had been in the service of the Cable Company. His office was at No. 60 New street, and he was very well known among men identified with the cable interests of the country.

NEW PUBLICATIONS.

THE TWENTIETH CENTURY ELECTRIC LIGHT—Mr. F. M. F. Cazin, Hoboken, N. J., has reprinted, in book form, a number of articles entitled "What Next in Electric Incandescent Lamp Making?" In addition there is a contribution on "An Important Natural Law Relating to Hydraulics, Nautics, Aeronautics and Astronomy." Mr. Cazin is the inventor of the Cazin lamp, which makes use of a filament embodying the applicability of rare earths as an illuminant. The book contains a great deal of very interesting reading. The frontispiece is an illustration of a fifty-candle-power Cazin lamp.

PHILIPPINE POWER-HOUSE AT THE LOUISIANA PURCHASE EXPOSITION—The Philippine Exposition Board of the United States War Department has issued a small pamphlet descriptive of the Philippine power-house at the Louisiana Purchase Exposition. The pamphlet contains twenty-one pages, and describes and illustrates very completely the power plant on the Philippine grounds at the World's Fair, St. Louis. The ground for the plant was surveyed on April 4, 1904, and the first machine was started on May 24. The boiler-room equipment consisted of four 256-horse-power Franklin water-tube boilers, arranged in batteries of two each. The engine room contained four generating units, delivering sixty-cycle, two-phase current at 2,200 volts. The machines ranged in size from 160 kilowatts to 240 kilowatts, and were driven by various types of engines.

PROJECT FOR THE PANAMA CANAL—Mr. Lindon W. Bates has published in book form, "A Project for the Panama Canal, with General Plans and Profiles of the Waterway, the Regulation Works, and the Terminal Harbors." Mr. Bates first takes up the factors and conditions on the Isthmus of Panama. He sketches the character and description of the present favored projects, and analyzes the tidal conditions at the Atlantic and Pacific sides of the proposed isthmian waterway. Criticisms are made of plans which have been considered, from time to time, and received more or less favor, and a critical analysis is made of the plan at the present time most favored by the commission which has the undertaking in hand. The project which Mr. Bates sets forth he considers more scientific and conducive to a considerable lower cost of construction and maintenance.

STATE AND TERRITORIAL GENERAL STATUTES RELATING TO THE USE OF STREETS AND HIGHWAYS—Under the title of "State and Territorial General Statutes Relating to the Use of Streets and Highways by Street Railway Companies, Water and Electric Light Companies," James S. Cummins, general counsel for H. M. Byllesby & Company, engineers, Chicago, Ill., has compiled a vast amount of matter of great value. The design of this book is to make a ready reference, giving the general laws of the various states and territories primarily governing the subject of franchise rights. Much preliminary expense has been incurred through an ignorance on the part of business interests on the subject of the fundamental laws governing the issuance of franchises. A preliminary reference to such laws would have shown at once whether the franchises in question were invalid or doubtful. The work is published by H. M. Byllesby & Company.

ELECTRICAL SECURITIES.

The four-day session of the market last week was full of activity, and, to some interests, was fraught with the elements of demoralization. The sharp break in prices brought about a number of notable declines, with the average at the close of the session considerably lower than for many weeks. In some quarters it is held that the rapid upward swing of prices which has marked events for several weeks past made inevitable the reactionary turn just witnessed; in fact, those interests which reaped the greatest benefit from the decline, materially helped to boost values latterly in order to make the market more vulnerable to the bear attack. It is significant, too, that the up-and-down movement has been almost entirely professional, the public stolidly refusing to accept the high valuation placed upon stocks by the boomers, and taking away a large part of the support upon which these interests relied in maintaining these issues at their high level. Notwithstanding the market decline, however, there appears to be no abatement in the general condition of prosperity. The continuance of favorable climatic conditions seems to assure early planting with the ultimate promise of bounteous harvests, and the mild weather prevailing makes for uninterrupted constructions, the apparent slumbering of destructive labor agitation helping materially to add to the stability of the prophecy of a good spring and summer season.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 22.

New York:	*Closing.*
Brooklyn Rapid Transit	66
Consolidated Gas	200
General Electric	180¼
Interborough Rapid Transit	206½
Kings County Electric	200
Manhattan Elevated	164½
Metropolitan Street Railway	120
New York & New Jersey Telephone	171
Westinghouse Manufacturing Company	192

Boston:	*Closing.*
American Telephone and Telegraph	144
Edison Electric Illuminating	255
Massachusetts Electric	68
New England Telephone	138½
Western Telephone and Telegraph preferred	99½

The American Telephone and Telegraph Company's instrument output for March broke all records for both gross and net output. The gross output of 169,159 for March compares with the previous high record of 134,301 made in February, while the net output of 121,514 compares with the previous record of 92,934 made in January. Coupons from the 5 per cent, three-year gold coupon notes of the company, by their terms payable on May 1, 1905, at the office of the treasurer in the city of New York, or, at the holder's option, at the office of the treasurer in the city of Boston, will be paid in New York by the Manhattan Trust Company, 20 Wall street, or in Boston by the National Bank of Commerce, Sears Building.

Philadelphia:	*Closing.*
Electric Company of America	12¼
Electric Storage Battery common	84
Electric Storage Battery preferred	84
Philadelphia Electric	11⅜
Philadelphia Rapid Transit	34⅜
United Gas Improvement	121⅞

Chicago:	*Closing.*
Chicago Telephone	142
Chicago Edison Light	165
Metropolitan Elevated preferred	61
National Carbon common	67
National Carbon preferred	115
Union Traction common	6½
Union Traction preferred	30

It is stated that Chicago Union Traction passenger earnings are showing an increase of $2,000 per day this year, due mainly to improved electric cars.

NEW INCORPORATIONS.

BENSON, MINN.—The Swift County Telephone Company. $25,000.

ITHACA, N. Y.—Spring Lake & Red Creek Telephone Company, of Westbury, Wayne County. $1,000.

AKRON, IOWA—Akron Telephone Company. $30,000. Directors: E. F. Cobb, C. B. Cobb and M. C. Pember.

SUMMITVILLE, IND.—Summitville Telephone Company. $5,000. Directors: R. W. Inglis, A. A. Inglis, T. E. Cartwright.

LAWN RIDGE, ILL.—Lawn Ridge Telephone Company. $3,500. Incorporators: J. W. Hurd, P. E. Phillips and William Gruner.

KENOSHA, WIS.—Burlington, Brighton & Wheatland Telephone Company. $5,000. President, Henry Runkel, Wheatland.

INDIANAPOLIS, IND.—The Dinkins Electric Company. $10,000. Incorporators: D. E. Dongan, Henry Hedley and J. H. Hall.

SPRINGFIELD, ILL.—Chicago, Joliet & Kansas City Railroad Company. To construct a line from Chicago to Joliet. $1,000,000.

CHUCKATUCK, VA.—Chuckatuck Telephone Corporation. $1,000. Incorporators: G. W. Butts, W. A. Willis, Robert C. Hall, all of Chuckatuck.

NEWARK, ILL.—Farmers and Merchants' Telephone Company, of Newark, $4,000. Incorporators: Peter Thompson, Albert Fowler, F. Sleezer.

NEW YORK, N. Y.—The Weiderhold Light Company. $200,000. Directors: George Lucas, Alfred Matthews and W. A. A. Brown, of Brooklyn.

McCONNELLSVILLE, OHIO—Riverside Telephone Company. $25,000. Incorporators: John D. Erwin, W. A. Cosgrave, W. P. Scott and others.

TIEMONTON, UTAH—Bear River Valley Telephone Company. $25,000. Officers: G. L. Carlton, president; John Sommer, treasurer and general manager.

NEW YORK, N. Y.—Williamsburg Power Company. $150,000. Directors: F. P. Foster and James Foster, New York city, and W. H. Robinson, Brooklyn.

NEWARK, N. J.—Mobile Electric Company. $100,000. Incorporators: Percy Ingalls, West Orange; Daniel H. Rich, East Orange; Earl E. Whitehorne, Verona.

BIRDSEYE, IND.—Farmers' Telephone Company. $110. Directors: George T. Veach, Joseph E. Harmon, W. H. Sinclair, Thomas Nelson and John W. Adkins.

HATTIESBURG, MISS.—The Hattiesburg Traction, Light and Fuel Company. $250,000. Incorporators: H. L. McKee, S. H. Witherspoon, J. M. McBeath and others.

PIERRE, S. D.—Palatine Telephone Company, of Palatine township, Aurora County. $24,000. Incorporators: A. D. Dougan, John Saville and others, of Plankinton.

ALBANY, N. Y.—Findley Lake & State Line Street Railway Company. $130,000. Incorporators: F. R. Nicols, Titusville, Pa.; F. Baeder, Corry, Pa.; E. A. Austin, Cutting, N. Y.

RICHLAND TOWNSHIP, ILL.—The Richland & Shelbyville Township Mutual Telephone Company. $2,500. Incorporators: L. N. Douthit, James Stewardson, William H. Brown.

EDGERTON, OHIO—Edgerton Telephone Company. $30,000. Incorporators: Jacob Zeeb, Claude E. Hoover, Walter S. Unger, James F. Reasoner, Lewis E. Graff and Emmet A. Geauque.

MONTGOMERY, ALA.—The Tallapoosa Water Power and Electrical Company. To build a dam at or near Sturdevant, for the purpose of generating electricity by water power. $100,000.

VANDALIA, ILL.—The Dieckmann Electric and Improvement Company. $110,000. To operate heat, light and power plants. Incorporators: George A. Dieckmann, J. R. Myers, J. F. Hibbetts.

PASSAIC, N. J.—Yanticaw Light, Heat and Power Company. $50,000. Incorporators: Michael F. Burns, Brooklyn, N. Y.; Solomon M. Shatzkin, Walter Kip, John J. Bowers, William H. Carroll, Leonard L. Grear, William H. Gilmor, Passaic.

BELLE PLAINE, IOWA—Iowa Valley Interurban Railway Company. $100,000. Incorporators: A. J. Hartman, W. A. Mall, M. J. Randall, H. R. Mosnat, George W. Voss, T. H. Milner, William A. Montgomery, C. J. Snitkay, Fred McCulloch, Thomas F. Murray, F. C. French.

DALLAS, TEX.—Texas Consolidated Long-Distance Telephone Company. To build and operate a long-distance telephone system in a number of counties of north Texas. $30,000. Incorporators: G. Locke Arnold, C. L. Simpson, A. W. Stearns, F. B. McElroy and A. J. Brown, all of Dallas.

ALBANY, N. Y.—Cohocton Telephone and Telegraph Company. To construct telephone lines connecting towns and villages in Steuben, Ontario and Livingston counties. $3,000. Directors: H. M. Bennett, Hornellsville, and A. H. Wilcox, H. P. Wilcox, C. C. Newcomb, F. E. Jackson, A. C. Westfall and E. S. Brown, of Cohocton.

PIERRE, S. D.—City Railway Company, of Sioux Falls. To construct an electric railroad system in Sioux Falls and in the surrounding country, to extend into the counties of Minnehaha, McCook, Turner, Lake, Moody in South Dakota, and Rock in Minnesota, and Lyon in Iowa. $500,000. Incorporators: J. R. Sheeley, Osceola, Iowa; G. W. Rhine, Tore Tiegen, Sioux Falls.

EDUCATIONAL.

SUMMER COURSES AT THE ARMOUR INSTITUTE OF TECHNOLOGY—The Armour Institute of Technology, Chicago, Ill., will offer courses in mechanical engineering, electrical engineering, telephone engineering, civil engineering, chemical engineering, drawing and shopwork, manual training, mathematics and physics, from June 26 to August 4, 1905. The course in telephone engineering is something new, and is designed to meet the wants of those who desire to devote their whole time to the acquirement of a knowledge of telephony as it is practised to-day.

SUMMER COURSES AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY—The Massachusetts Institute of Technology, Boston, Mass., announces a summer course during the months of June and July, supplementing the work of the regular school year. The summer courses are undertaken primarily for the benefit of two classes of students: first, for those who wish to prolong their stay in summer in order to distribute their work over a larger portion of the year or to gain more time for advanced work in the regular courses; second, for those who, through illness or other causes, have deficiencies to make up. The summer courses are also open to persons not students in the Institute of Technology, if they possess the necessary qualifications.

ENGINEERING SOCIETIES.

STEVENS CLUB OF NEWARK—The Stevens Club of Newark, N. J., held its second regular meeting at C. A. Stetter's restaurant, Newark, on the evening of April 14. After the transaction of business a paper on "Motor-Driving of Machine Tools" was presented by Mr. E. R. Douglas, of the Crocker-Wheeler Company. The paper dealt with the various methods of motor driving, and discussed the great advantages to be obtained by the use of variable-speed motors and high-speed steel. Comparisons of the cost of performing various operations on belt-driven and motor-driven tools were made, showing the saving due to the use of the motor.

TRANSACTIONS OF THE AMERICAN ELECTROCHEMICAL SOCIETY—Vol. vi, of the transactions of the American Electrochemical Society, covering the meeting which was held at St. Louis, Mo., September 13 to 16, 1904, in conjunction with the International Electrical Congress, has been received. This volume is divided into two sections, the first comprising a series of papers which was read at the sixth general meeting of the society. The second part comprises those papers which were read at the joint meeting of Section C of the fifth International Electrical Congress and the American Electrochemical Society. There are in all twenty-one papers, some of which are of much interest. "The Chemistry of Electroplating," by Dr. Wilder D. Bancroft; "The Carbon Cell," by F. Haber and L. Bruner; "The Electrochemical Series of Metals," by Louis Kahlenberg; "A Study of the Metals Used in Standard Cells and Their Preparation," by H. S. Carhart and G. A. Hulett; "The Electrometallurgy of Iron and Steel," by Paul L. T. Héroult, and "Electrolysis and Catalysis," by W. Ostwald, are perhaps the papers which attracted the most attention. While these transactions are distributed to the members of the society and the members of the Faraday Society, of England, only, they can be purchased by others. The price is three dollars; to colleges, technical societies and journals, two dollars. The secretary of the American Electrochemical Society is Mr. S. S. Sadtler, 39 South Tenth street, Philadelphia, Pa.

INDUSTRIAL ITEMS.

THE CORLISS ENGINE WORKS, 4041 North Fifth street, Philadelphia, Pa., is distributing a catalogue describing the "Rickard" Corliss engine.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, has issued bulletin No. 19, describing direct-current fan motors. These include both desk, wall and ceiling fans.

THE BRYAN-MARSH COMPANY, Chicago, Ill., has moved its office from the Fisher Building to 1113-1116 Manhattan Building. At this place the company will occupy larger quarters.

THE A. D. GRANGER COMPANY, 95 Liberty street, New York city, has issued a catalogue describing the "Vulcan" shaking and dumping grates, also boiler fronts and other boiler accessories.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has issued bulletin No. 70. This bulletin describes single-phase motors for elevator, hoist and traveling crane service.

THE AMERICAN ELECTRIC AND CONTROLLER COMPANY, 12 Dey street, New York, has issued bulletin No. 3, describing the solenoid switches for alternating current which are made by it.

H. M. BYLLESBY & COMPANY, Chicago, Ill., have been appointed managers and engineers of the gas and electric properties of the San Diego Consolidated Gas and Electric Company, of San Diego, Cal.

THE BROWNING ENGINEERING COMPANY, Cleveland, Ohio, is distributing some attractive literature concerning its locomotive crane. Other bulletins describe the coil spring friction clutch and an automatic grab bucket of the improved clam-shell type.

THE ELECTRO-DYNAMIC COMPANY, Bayonne, N. J., will be pleased to send circular No. 8 and circular No. 10, series B. These circulars describe, respectively, controlling apparatus for the "Interpole" variable-speed motor, and the constant-speed motor, type I.

THE COMMERCIAL ELECTRICAL SUPPLY COMPANY, 1007 Market street, St. Louis, Mo., will be pleased to send its descriptive literature containing "Trojan" electric fans. These are made both in desk and ceiling types, and contain many features of particular merit.

THE WILMARTH & MORMAN COMPANY, Grand Rapids, Mich., has issued catalogue No. 90, describing the new "Yankee" drill grinder made by it. The catalogue describes and illustrates a large number of different types of drill grinders, and also gives some information relating to drills.

THE F. BISSELL COMPANY, Toledo, Ohio, is distributing a circular, calling attention to the applicability of the Burns adjustable telephone. In addition to a special form of telephone instrument, the adjustable holding rack is made so as to accommodate any form of standard desk telephone.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., will be pleased to send issue No. 3 of its electrical catechism. The introductory to this number is a quotation from Sir Oliver Lodge, and the rest of the number is given up to a description of the application of electrical measuring instruments.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Ames, Iowa; Liberty, Ill.; Daykins, Neb.; Higginsville, Mo.; Ashton, Ill.; Sheffield, Ill.; Walnut, Ill.; Lamoille, Ill., and Buffalo Gap, S. D.

I. B. WILLIAMS & SONS, 45 Dey street, New York, have issued a booklet entitled "What a Belt Should Do." In it are discussed the proper care and application of belts, together with rules for horse-power of belts, and also some notes on the adaptation of the different types of belts to various uses.

THE SHAW ENGINEERING AND MANUFACTURING COMPANY, Fuller Building, New York city, has been retained as consulting electrical engineer for the Asbury Park Pier Company, in connection with the installation of an isolated plant. There will probably be installed 10,000 incandescent lamps, and a 200-arc lighting equipment.

THE COLONIAL FAN AND MOTOR COMPANY announces that it has moved its office from Ravenna to Warren, Ohio. This is necessitated by the increase in business. The company will now be in a much better position to handle orders and to make more prompt shipments than from the office at Ravenna.

FRANK B. GILBRETH, Boston, Mass., will send, upon request, his illustrated bulletin calling attention to his system of rapid construction. Mr. Gilbreth acts as general contractor for all kinds of construction work, and has been remarkably successful in carrying to completion in short time some very large installations.

THE NERNST LAMP COMPANY, Pittsburg, Pa., is distributing a very attractive pamphlet entitled "Church Lighting by Electricity." This gives some interesting information concerning the problem of church lighting by electricity. Illustrations are given, showing the application of Nernst lamps for this particular form of illumination.

THE CROWE METAL MANUFACTURING COMPANY, Chicago, Ill., is distributing a novel catalogue showing, in a very attractive manner, the form of stampings and name-plates which it manufactures. These name-plates are printed in characteristic colors, and in bronzes of various forms, so that a very realistic reproduction is possible.

THE ELECTRIC UTILITIES COMPANY, Fuller Building, New York city, is distributing a catalogue descriptive of the "Metaphone," which is an interior telephone, consisting of a transmitter and receiver mounted on opposite ends of a short metal handle. The catalogue describes various uses of the "Metaphone," including office and hotel call systems.

THE BRYANT ELECTRIC COMPANY, Bridgeport, Ct., has issued a very extensive catalogue, illustrating and giving dimensions of the electrical supplies which it manufactures. This book is very complete, and in its 210 pages includes a very wide range of electrical supplies. A carefully arranged index makes it easy to find any particular piece of apparatus.

THE WILLIAMS TELEPHONE AND SUPPLY COMPANY, Cleveland, Ohio, has issued a booklet which, under the title of "A Short Trip to Town," illustrates and describes the telephone apparatus manufactured by the company. This apparatus includes lightning arresters, transmitters, receivers, magneto generators, induction coils, extension bells and complete sets.

W. H. SCHOTT, 1218 Marquette Building, Chicago, Ill., designer and builder of the Schott systems of central station heating plants, has published an attractive booklet entitled "From Necessity to Luxury." This sets forth the advantages of a central station heating plant. Attention is called to the convenience and accommodation which are inherent with this form of residence and large-area heating.

THE NEW YORK SAFETY STEAM POWER COMPANY, New York city, will occupy offices on the fourth floor of the Engineering Building, 114 Liberty street, New York city. The company will also maintain an erecting and repair department storeroom in New York city, and a complete stock of finished products will be carried ready for immediate shipment from the works, which is within twelve hours of New York.

THE WELLMAN-SEAVER-MORGAN COMPANY, Cleveland, Ohio, is distributing a circular describing the Johnson patent arch plate. This plate is to facilitate repair to open-hearth furnace door arches. It fits on the ram of the charging machine, and can be quickly placed in position. It shields the workmen from the heat in the interior of the furnace, thus enabling repairs to be made without shutting down the furnace.

THE GERMANIA ELECTRIC LAMP COMPANY, Harrison, N. J., has been incorporated with a capital stock of $125,000. The president is George Campbell; vice-president, S. G. Waterman; secretary and treasurer, Edward Campbell. The company expects to make extensive enlargements to its plant in the near future, which will not only enable it to keep up its high standard of

Germania lamps, but which will also give facilities for a greatly increased output.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., is distributing a very attractive booklet entitled "Summer Comforts." This booklet describes, in very interesting fashion, the part played by "Wood" fan motors in producing summer comfort. The various details of "Wood" fan motors are described, and the text is illustrated by a number of engravings showing the assembly and application of the various types of fan motors.

THE CHASE-SHAWMUT COMPANY, Newburyport, Mass., has published a new bulletin, No. 30, covering "Boston" cable clips and "Shawmut" marlin hangers. The "Boston" clip is the original metal cable clip which has been manufactured by the Chase-Shawmut Company for a number of years. The "Shawmut" marlin hanger is a new departure with this company. Copies of the bulletin will be sent to any one interested upon request.

DODGE & DAY, engineers, Philadelphia, Pa., who have for the past three years designed the electrical equipment for operating the hoisting and conveying machinery built by the Dodge Coal Storage Company, will also have charge of similar work in connection with the telepherage apparatus that will now be manufactured by the Dodge Coal Storage Company as a result of its acquisition of the United Telpherage Company's interests.

JOSEPH H. THOMPSON, JR., 11 Broadway, New York city, will be pleased to send his new catalogue of electrical and steam machinery for immediate delivery. This is designated as "Bargain List No. 3." The list contains a large variety of direct-connected units, compound and simple engines. boilers, generators and motors, alternators, railway motors and cars, arc dynamos, steam shovels, and a large assortment of miscellaneous equipment.

THE EWING-MERKLE ELECTRIC COMPANY, St. Louis, Mo., is distributing publication No. 25, entitled "A Guide to Telephone Promotion and Organization." The book tells the advantages of the telephone on the farm, and gives estimate of the cost. Directions for organizing a farmers' mutual telephone company, together with a model constitution and by-laws, are given. Directions for erecting and operating the lines comprise a large part of the book.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., announces that it has designed and now has ready for the market an entirely new line of induction motors which it can offer at considerably lower prices than the motor it has heretofore been furnishing. A careful study of the design of induction motors has been made, covering a period of some years, with a view not only to improving the motors, both mechanically and electrically, but also to cheapening their cost.

THE FREDERICK PEARCE COMPANY, New York city, has been incorporated under the laws of the state of New York, to continue the business of Frederick Pearce, successor to Pearce & Jones, manufacturing electricians. The business has been successful, and the aim is to do only strictly first-class work, the basis upon which the company has operated since its establishment in 1872. Mr. Frederick Pearce is president of the corporation; Charles F. Pearce, vice-president; George H. Tamlyn, secretary and treasurer. In addition, Mr. Walter H. Pearce is one of the directors.

W. N. MATHEWS & BROTHER, 219 North Second street, St. Louis, Mo., are distributing a handsome booklet entitled "Anchors That Hold." This booklet gives a few facts concerning the "Stombaugh" guy anchor. A very interesting contribution is the account of tests made by Professor R. C. Carpenter, of Sibley College, Cornell University. This describes several very severe tests to which this guy anchor was subjected, and develops a formula for computing the resisting power of the anchor. A number of illustrations are given, showing typical applications of the "Stombaugh" anchor.

THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD COMPANY, through the office of the general passenger agent, Grand Central Station, New York city, is distributing No. 38 of the *Four-Track* series. This gives an idea of what the New York Central lines are doing to give service to all parts of the country. This great system of American railways accommodates more than one-half the entire population of the United States, and a large proportion of the population of the Dominion of Canada. It also handles considerable business to and from the republic of Mexico. The company has offices, with its own correspondents, in every country on the globe, placing a belt of information bureaus around the earth.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., announces the following contracts, which have been closed very recently: as an extension to its system the Louisville Railway Company will install two 750-kilowatt, three-phase rotary converters, six 300-kilowatt air-blast transformers with blower outfits, and two switchboards. The United Railways and Electric Company, of Baltimore, has contracted for three 1,000-kilowatt rotaries and nine 350-kilowatt air-blast transformers. These will operate on a 13,000-volt line, transforming to 330 volts. Eighteen rotary converters, with a total capacity of 27,000 kilowatts, in 1,000 and 1,500-kilowatt units, will be placed in substations for the New York Central & Hudson River Railroad Company. Two 1,500-kilowatt, direct-current generators will be built for the Carnegie Steel Company, to furnish power to two 1,500-horse-power, 250-volt motors. For the protection of this apparatus, 10,000-ampere circuit-breakers will be mounted on the switchboard. These motors will be the largest ever built for this voltage. The company's name is generally associated with large machinery and extensive enterprises. An immense business, however, is done in small apparatus. For the driving of machines in its works, the Surpass Leather Company, Philadelphia, Pa., has ordered eighteen induction motors, varying in size from one-half to fifty horse-power. The State Company, of Columbia, S. C., has contracted for twelve direct-current motors, ranging in capacity from one to twenty horse-power; and Murdock, Kerr & Company, of Pittsburg, will receive the same number, having various outputs from two to seventy horse-power.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., announces the purchase by the Detroit United Railway of one heavy-duty, cross-compound Reynolds-Corliss engine, 32 by 68, for direct connection to a 1,500-kilowatt generator. This will be installed in the company's station on Atwater street, in Detroit, Mich., where it has been found necessary to provide for an extension to the existing power plant. The Wheeling & Lake Erie Railroad Company has ordered from the Allis-Chalmers Company's electric department, the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, equipment for its new machine and car repair shops at Canton, Ohio, consisting of two engine-type 250-volt generators, one of which is 150 kilowatts and the other seventy-five kilowatts, and sixteen motors with capacities aggregating 300 horse-power. The Mansfield, Ohio, Railway, Light and Power Company, which is completely revamping its power plant, has placed an extensive order for the necessary machinery, including one 250-kilowatt and two 530-kilowatt Bullock generators, one 500-kilowatt and one 600-kilowatt railway generators, one 125-horse-power motor and one motor-generator set. The contract goes to Allis-Chalmers Company, which will construct the apparatus at its electrical works in Cincinnati. The Allis-Chalmers Company has also received an order from Chapin & Gore, Chicago, for three Reliance engines and three generators for direct connections to same, complete with switchboards, etc., to be installed as a plant for electric light and power used in the Majestic Theatre and office building in that city. The Chicago & Northwestern Railway Company has placed an order with the same company for two Reliance 32 by 36 inches belted engines and two 250-kilowatt direct-current Bullock generators. These will be installed as two separate units in the power-house of the company at Buxton, Iowa, and used for driving machinery in the coal mines there, which furnish fuel for some of the western divisions of the road. It is also announced that the Turner Falls Company, of Turner Falls, Mass., is to erect a power plant consisting of four 1,000-kilowatt generator units, two 300-kilowatt generators for light loads, and one seventy-five-kilowatt exciter generator, all water-wheel driven and direct-connected to water-wheel shafts, together with one motor-driven exciter of seventy-five kilowatts. The generators will all be alternating-current, three-phase, sixty-cycle, 2,000-volt machines. One 1,000-kilowatt Bullock generator and the seventy-five-kilowatt exciter are to be installed shortly, the apparatus having been ordered from the Allis-Chalmers Company. The water power at Turner Falls is being developed for commercial uses, and promises to become a factor of considerable importance in the industrial activity of that section of Massachusetts.